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THE INSTITUTE CONVENTION.

The Buffalo meeting of the American Institute of Electrical Engineers was unquestionably one of the most successful in the history of that body. Indeed, if judged by the timely nature and practical engineering interest of the majority of the papers read, and the liveliness and value of the discussions, it ranks as the most successful, not excepting the Chicago World's Fair convention. The attendance was also very good, and surprisingly well sustained, although the convention opened on Tuesday and did not adjourn until Saturday afternoon. On the other hand, a disagreeable feature was the entire failure in the execution of the carefully prepared plans for the reception of the members and the guests, both upon the arrival at Buffalo and upon the opening of the convention, which failure was the more marked through contrast with the admirable manner in which the programme up to Buffalo had been carried out in its slightest details. Another annoyance was incident to the convention being held in connection with an exposition. Traveling long distances in sultry weather in street cars filled to suffocation, and with the entire commercial element of the city apparently banded to extort, if possible, your last penny—these are conditions not conducive to that serenity of mind which should preside over the discussion of questions of science. Though the Institute met within the Exposition grounds by invitation, the members were accorded no privileges as at Paris. They were required to pay each time they entered the grounds, which in some cases, owing to the Institute programme, involved two admission fees in a day. The Buffalo meeting also showed once again that the most objectionable feature of meetings of the Institute in connection with expositions is the little opportunity afforded the members in attendance for the extension of acquaintanc and the personal interchange of ideas.

In view of the general objection to Institute meetings in connection with expositions and the particular ones arising from the Buffalo experience, we hope the Institute may not consider it again desirable to assume the role of an unappreciated side show to an exposition. If some ulterior attraction is thought necessary to secure a large attendance, this might be found in a summer resort, which would have the additional advantage that relaxation could be united with proper attention to the professional objects of the gathering. If such meetings were held the latter part of June before the summer exodus to seaside and mountain fairly sets in, we venture to say that no difficulty would be encountered in obtaining at moderate expense first-class accommodation in the highest class hostelry.

THE NERNST LAMP.

A large amount of our space this week is occupied by the Institute paper of Mr. Wurts on the Nernst lamp, which we print in full. The subject is one of much importance to those engaged in the electric lighting industry, and of interest to all concerned in electro-technics, and the paper embodies a large amount of data now for the first time made public. Proposing to discuss the paper somewhat fully ourselves, as soon as opportunity offers, we can in the meantime commend it to our readers, and express pleasure at the notable advances therein recorded.

Trolleys and English Railroads.

The decline in the net revenues of English railways is attracting attention. The figures are, indeed, quite striking, and suggest the need of an early remedy. Mr. H. Allaway, a well-known financial expert, in summing up the conditions in the *New York Times,* shows for last year a net falling off of $7,000,000 in the returns of 15 of the leading systems. The London & Northwestern line pays this year a dividend of only 2¼ per cent, or less than at any time since 1863, and the chairman ascribes the decline as due to the competition of the new trolley systems. It is now stated that the company will take up and deal with this problem; in fact, it must do so, just as the New York Central is doing—for it is now rumored that the Central has retained for this work Mr. Bion J. Arnold, who did the pioneer long-distance railroad work out West; in fact, his commission is said to include the planning of a scheme to operate the New York Central by electricity, all the way from New York to Albany.

Returning to the English roads, it is obvious that while they are not feeling the pinch of hard times, as gross traffic is virtually heavier than ever, the cost of steam operation can no longer be endured. We venture to think that England is about to demonstrate on a grand scale the application of electricity to heavy railway work, and there are many conditions there which are more favorable than those to be encountered here. In reality, the trolley competition in England looks to an American as almost negligible, but it is evidently felt. Moreover, there is the still new competition of the automobile. Just what that will amount to no one can tell, but King Edward makes his run from London to Windsor in about an hour, quite often, it is said, and every time he or others like him do that, the railroads are out a handsome fare.

Incandescent Lamps at the Buffalo Exhibition.

The beauty of the electric lighting at the Buffalo Exhibition is due to the fact that it is all incandescent lighting (with the exception of a few flambeaux of natural gas). These lamps are nearly all 8-cp lamps. The total number of these lamps has not yet been officially announced. It is said, however, that 4000 horse-power are transmitted to the Exhibition from Niagara and used for lighting purposes. If this is the case, and if each lamp takes, say, 30 watts, then there will be about 100,000 lamps employed in all. It is curious to remember that each incandescent lamp filament weighs only about a milligramme, and that consequently the entire mass of the lamps collected together would only be a few ounces, making a parcel that could easily be carried in the hand.

A Retrospect of Niagara Power.

One of the most striking papers read at the Buffalo meeting of the A. I. E. E. was the review of eight years of power transmission at Niagara by Mr. L. B. Stillwell, who, as engineer for the Westinghouse Company and afterwards for the Niagara Power Company, has unequaled opportunities for studying the situation. Now that the battle of systems is over and the smoke thereof has blown away, one can look at the situation fairly and discuss the merits of the installation without the imputation of favoritism, and Mr. Stillwell himself does not hesitate to do so. He has a very pardonable pride in the great plant, the success of which he did so much to ensure, and may well be gratified at the few changes which have been necessary in the later equipment. To understand the engineering peculiarities of the Niagara plant aright one must realize the conditions under which the work was initiated. It was organized as a comercial enterprise when there was no art of electrical power transmission. Even when the contracts were let, polyphase transmission was barely yet in the commercial stage of development on the continent, while in this country there was nothing running outside of the manufacturers' workshops, although several plants were under construction. Started at such a time, the original scheme boldly contemplated the building of a great manufacturing metropolis above the Falls, where would be gathered, drawn by the irresistible attraction of cheap power, the larger industries of half a continent. Hence to obtain available space for such a colossal enterprise the land above the Falls was secured and the huge tunnelled tail race was constructed at an expense enormously greater than would have been necessary if the hydraulic plans had contemplated merely the gigantic power transmission plant which actually has grown up. Entailed upon the system by this fundamental departure were striking hydraulic details, technically magnificent, but utterly without the scope of the engineering plans which would normally be made for the utilization of such a power.

To a lesser extent the same original conception of a power city dominated the electrical development. As Mr. Stillwell very frankly indicates, with an extended power transmission service in view, the three-phase rather than the two-phase system would have been the logical choice, although now through the introduction of phasing transformers, the use of three-phase or two-phase generators is a matter of individual taste, almost of indifference. The choice of two-phase at the time was probably due mainly to various non-technical considerations, although one of the consulting engineers later displayed something akin to the odium theologicum by damning the three-phase system for this case on account of the reputed effect of unbalancing upon the lights, while in the same breath he sanctioned the use of a frequency which made lighting from the Niagara circuits impracticable. That the frequency chosen was below that suitable for incandescent lighting was unfortunate in view of later developments, and Mr. Stillwell expresses a strong personal preference for 30 cycles which would, in part at least, remove this difficulty. When the function of the Niagara plant expanded from local power supply to the broader and more brilliant field of electrical distribution over a radius of many miles, lighting became a consideration of no small importance, and it is certainly a pity that the major part of the lighting of Buffalo should have to be accomplished via motor-generators to bring the frequency to a feasible figure. The only material reason for a frequency even so low as 30 cycles is some added facility in the use of rotary converters, and in point of fact substantially all transmission plants designed for the general commercial distribution of electrical energy have deemed it wise to operate at 50 to 60 cycles, even when supplying a considerable load for electric traction and operating, like the great system recently inaugurated in California over 150 to 200 miles of line. On the whole, electrical energy at 60 cycles is a more saleable article than at 25 cycles, and it seems to us at least a debatable question whether in adhering to the old frequency for the immense new plant there is not too great a sacrifice for the sake of uniformity.

The advantage to the art from the colossal scale of the Niagara work has been inestimable. Problems of every kind have presented themselves for solution and have in general been successfully solved. The mere matter of switchboard construction on the gigantic scale there needful almost called for the development of a new art. The solution adapted from railway switch tower practice is certainly beautiful. The switchboard for eleven 5000-hp generators must of necessity be too large for effective manual control, but a board in miniature controlling and interlocked with the main board is both wonderfully effective and delightfully facile of operation. One of the many important matters brought out by Mr. Stillwell, and which we are particularly glad to see presented in its true light, is the question of the

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general use of conduits for high-pressure transmission circuits. It is a good thing to have their prohibitive cost put squarely upon record. It is so great that even if they had an infinitely long life, which is hardly to be anticipated, they would still be an impossible burden to carry. There is every reason to believe that for transmission circuits at the voltages now generally employed, an overhead line can be made on the whole fully as reliable as a conduit and at a small fraction of the expense. On the new Niagara line there is shown an appreciation of the weak points of overhead construction that is very gratifying. It is indeed a strange thing that until very recently power transmission companies stuck rigorously by the pins that had originally been planned for telegraph wires. Work on a large scale must imply some variation from small models, and lines of 500,000 cir. mils. cables certainly require strong suspending parts. Of troubles on the lines due to the ordinary course of accidents, the Niagara plant has had its share, and from what Mr. Stillwell indicates, we should judge that certain phenomena connected with resonance had been not altogether unknown, but with all this the plant has done its work well. We note with strong approbation that its engineers have stood out firmly for first-class inherent regulation, and have obtained it. We believe that it is necessary for first-class service in a long-distance transmission plant. The generators are not as cheap to build as those that regulate poorly, but they stand up to their work under variations of load and of power factor in a way that greatly facilitates good service. In the long run, good service is the criterion of success.

SURGINGS IN CIRCUITS.

Mr. C. P. Steinmetz, in his valuable paper read before the A. I. E. E. Convention last week, has added another contribution to the Transactions which will become classical. The paper deals with the waves which occur on long-transmission lines having distributed inductance and capacity. For the sake of simplicity, he substitutes localized capacity for distributed capacity, and assumes that the transmission line has all its capacity connected to the circuit at the center of its length. This reduces the case to a pair of wires half the length of the actual line, possessing resistance and inductance, and terminating in a condenser of the total line capacity. In any such circuit it is known that if we suddenly apply a simple alternating e. m. f. at the generating end of the line, a simple alternating current will be found to flow in the circuit after a considerable number of cycles have been executed, or periods have elapsed. But in the initial stage of the operation there is a disturbance, which dies away logarithmically. This disturbance, which appears in the differential equations as an evanescent constant, is the surging effect of applying an e. m. f. to the circuit, as though a direct-current e. m. f. of equal magnitude had been applied to the imaginary half-line and terminal condenser. The disturbance is oscillatory, and has the frequency of the half-line circuit, and not the frequency of the alternating-current generator. The magnitude of the surging e. m. f. cannot exceed the magnitude of the impressed e. m. f. at the top of its wave, so that the total instantaneous e. m. f. brought to bear upon the line cannot be more than the maximum cyclic impressed e. m. f., plus the temporary surging e. m. f. of equal magnitude; i. e., a total of double the maximum impressed e. m. f. If the impressed e. m. f. is applied to the circuit at a time when the instantaneous e. m. f. is zero, or nearly zero, then the surge will be very small.

On breaking the circuit there will be similar surges. The simplest way to deal with them is to consider that when a current is flowing in the imaginary half-line circuit with terminal condenser, that current will have an electromagnetic *vis-viva* equal to LI^2, where L is the total inductance of the half-line circuit, and I the strength of the current. This represents energy stored up in the surrounding ether and associated with magnetic flux. If the circuit is instantly broken, this electromagnetic energy will be liberated in a manner that will give rise to surgings, and if the system had no resistance, either conductive or hysteretic, there would be no energy dissipated, the energy would be alternately electric and magnetic, and the surgings would go on indefinitely in the disconnected circuit. The electromagnetic energy of the type LI^2 will disappear as soon as the surging current is stopped by the condenser, and will take the form of electrostatic flux energy in the condenser, of the type CE^2, where E is the surging e. m. f. and C the capacity of the condenser. At the moment, the current has vanished, the condenser energy is equal to the previously magnetic energy, and consequently the surging e. m. f. in the condenser is $I\sqrt{L/C}$ volts, or $I\sqrt{KX}$, where K is the reactance of the condenser, and X the inductance reactance of the half-line circuit. That is to say, the e. m. f. at the first surging wave will have the strength of the current broken in the circuit, times the geometric mean of the two reactances of the half-line circuit. This surging e. m. f. may be considerably greater than the e. m. f. supplied by the generator when the current interrupted is full-load current, on the assumption that the interruption occurs at the top of the full-load current wave. If the interruption occurs at or near the bottom of the wave, the surge will be small. Moreover, in circuits of large inductance and small capacity, such as overhead wire circuits, the condenser representing the total capacity of the line will be comparatively small, and the surging e. m. f. which will store up in that capacity an energy equal to the electromagnetic energy of the current at interruption, will be much greater than where the capacity is large, as in underground wires, where, moreover, the inductance is somewhat less. Consequently, in underground wires the surge is fortunately not so great as in overhead wires, other things being equal.

The most dangerous surgings are those which may happen when a short-circuit occurs at the receiving end of the line, and when this short-circuit current is suddenly interrupted. Here, owing to the strength of current momentarily flowing, the stored magnetic *vis viva* LI^2 may be far greater than that accompanying the full-load current wave crests. If such a short-circuit current is interrupted suddenly at the top of the wave, the surge e. m. f. of an overhead circuit may be 100 times greater than the e. m. f. of the generator, as Mr. Steinmetz pointed out. The surging frequency depends upon the length of line and upon the reactances of the line, but is usually considerably higher than the frequency of the working alternator. It is evident, therefore, that there is danger to insulation in breaking an alternating-current circuit at the current-wave crests, and the danger increases with the strength of the current. It would also seem that if a condenser capable of standing the working pressure, and of suitable capacity, were brought into connection with the circuit at the moment when the circuit was broken, the surge of e. m. f. might be kept from rising by storing the energy in this condenser. From this point of view, capacity in a transmission circuit is useful, except in so far as its charging current or hysteretic loss may be objectionable during operation.

The important point brought out by the paper is that while resonance during the operation of a long-distance alternating-current circuit may be quite small, this resonance being due to forced oscillations from the generator, due to the fundamental frequency, or odd multiple harmonics thereof, there may be considerable danger from line resonance at making, breaking or suddenly changing the load on the circuit, due to free oscillations in the circuit, and that the disturbance due to suddenly interrupting a short-circuit is the most of all to be feared.

Electrical Developments in England.

Mr. George Westinghouse returned last week from England, where he has been since May 1 on business in connection with the development of the British Westinghouse Company. In view of the rumors of a clash of interests between himself and Mr. Yerkes about the electrical equipment of the District Underground Railway in London, of which road Mr. Yerkes has the control, Mr. Westinghouse authorized a denial of the story, and said: "There are absolutely no differences between Mr. Yerkes and myself. As a matter of fact, he has awarded to the British Westinghouse Company the contract for engines of 30,000 horse-power and generators for his Metropolitan District Railway. He will require much more apparatus, the manufacture of which in England will be advantageous to his interests. It may, therefore, be said that his interests and mine are in harmony, with the probability that these operations, respectively, will be mutually helpful."

As to the hostility said to have developed against the American control of the Metropolitan District road and against the improvements by American companies, Mr. Westinghouse said:

"The public want the improvements that are now under way, and while they might prefer to have them as the result of British enterprise, they are glad to have them regardless of the source. Nine-tenths of what has been cabled to America on that subject is exaggerated. I believe such mischievous statements, made by disappointed or scheming people to the London representatives of American newspapers, do great harm to the development of American interests."

Operating the New York Central Railroad Tunnel.

In accordance with rumors that have been current, it is now stated that engineers of the New York Central Railroad have prepared a plan designed to do away with the troublesome smoke and gas nuisance in the Park Avenue tunnel, through which more than 500 trains pass daily. This plan has been laid before President Newman, and will be submitted by him to the executive committee. Two tracks extend through the central section, which is ventilated by frequent large openings into Park Avenue. On each side of this section is a dark tunnel accommodating a single track. These side tunnels are ventilated only by side openings into the central section. It is the purpose of the plan to devote these side tunnels entirely to suburban traffic, which is to be operated entirely by electric motive power. From a convenient point above the Grand Central Station the grade of the side tunnels will be lowered radically so as to form an underground loop pasing into and across the station below the main tracks. The main tunnel is to be more effectively ventilated, possibly by electric blowers.

The estimated cost of the proposed changes, which are here outlined only in a general way, is between $6,000,000 and $7,000,000.

Electrical Engineers of the Day—IX.

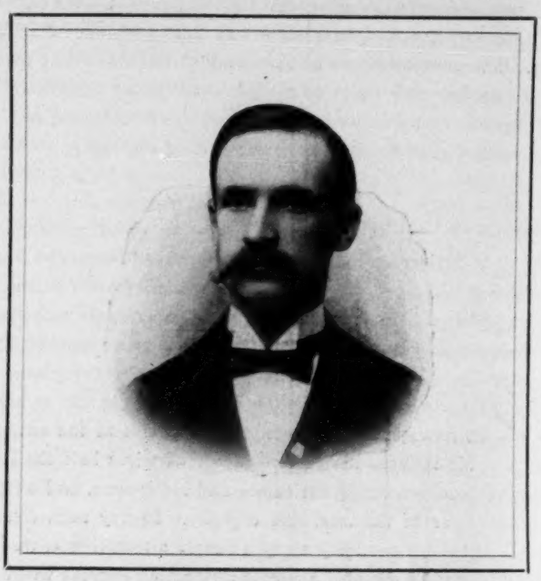
GEORGE T. HANCHETT.

George Tilden Hanchett was born at Hyde Park, Mass., Sept. 4, 1871. While attending high school he became interested in electricity, and by working evenings and during vacations in a local machine shop, succeeded in completing a machinist's apprenticeship. During this time he established a little laboratory, which included some light machine tools, and built small dynamos and motors, induction coils and similar electrical apparatus. Later he began to do work as opportunity offered for local electrical concerns. Entering the Massachusetts Institute of Technology in 1889, he was graduated four years later from the course of electrical engineering with the degree of S. B. While at the Institute and during summer vacations he persisted in his policy of gaining practical experience in workshops, and during this period spent some time in the factory of the Brush Electric Company at Cleveland, where he acquired a practical familiarity with the design, construction and testing of electrical machinery.

Shortly after graduation Mr. Hanchett accepted a position with E. P. Roberts & Co., of Cleveland, and became engaged in laying out wiring plans and designing switchboards, and in other consulting engineering work. Quite a number of local installations in Cleveland were installed from plans and specifications which Mr. Hanchett prepared, among others the Garfield Building, Kennard House, Hollenden Hotel, Soldiers' Monument and Pilgrim Church. In 1894, as electrical assistant of Mr. Charles O. Lenz, he continued the same line of work in Providence, R. I., where he prepared wiring plans for a number of large installations, including the State Armory in Providence, police station and the Auditorium and Broad Street Power Building in Pawtucket, besides doing much detail work pertaining to electrical engineering. In 1895 he accepted a position with the Collyer Machine Company, of Pawtucket, R. I., for which he designed and built a line of electrical machinery, and had general charge of the electrical work of that company.

In the fall of 1895 Mr. Hanchett came to New York to accept a position on the editorial staff of the *Electric Railway Gazette*, and upon the discontinuance of that journal was transferred to the editorial staff of the *Electrical World*. In the fall of the following year Mr. Hanchett opened an engineering office in New York. For the first year the larger part of his time was retained by the Walker Company, of Cleveland, Ohio, but subsequently his consulting business became more general.

Mr. Hanchett has conducted a number of experimental investiga-



tions as opportunity and facilities afforded, and did some work on Röntgen rays, induction coils and electrolytic interrupters at the time when these were of prominent public interest. The results of these researches have been principally published in these columns. We may note as of particular interest the establishment of several new principles in the construction and operation of induction coils, and an investigation of certain anomalous voltage and current phenomena in electrolytic interrupter circuits. In this work Mr. Hanchett gives evidence of marked originality as an investigator. Indeed, originality in thought and methods has been characteristic of every phase of his professional career.

In 1898 Mr. Hanchett invented and placed on the market in connection with Mr. F. B. Sage a direct-reading ohmmeter, which has met with considerable commercial success. Of late years much of Mr. Hanchett's work has been in machine design, and among more recent examples may be mentioned several automobile controller and motor designs, automatic switches for the Murphy Safety Third Rail Electric Company, and a reversible motor compressor for the same company. Latterly he has had entire charge of the experimental work on the Murphy system, and the Baltimore tunnel plant of this system, described in these columns, was designed and installed under his supervision. A large part of Mr. Hanchett's work has been of a varied character, such as tests, expert opinions, investigations and the design of special machinery work requiring much skill and judgment, but not of a kind that brings general professional recognition.

He is a member of the American Institute of Electrical Engineers, and the author of a work on "Modern Electric Railway Motors," which has had a large circulation.

Some Details of German Electrical Generating Station Practice.

BY E. KILBURN SCOTT.

THE boiler houses in German central stations visited recently by the English Institution of Electrical Engineers, are all exceedingly well arranged, and they have, in fact, the appearance of having been designed throughout by the boiler contractor, instead of the boilers being placed in a building and in connection with apparatus designed by some one else.

The double (or elephant) boiler is quite commonly used, and the fire grates are in most cases inclined so as to be self-feeding. This appears to be necessary for the proper burning of the brown lignite coal which is used, it being a coal which gives plenty of ash, but practically no clinker. The boilers are usually arranged in pairs with a gangway all round, so that it is possible to walk quite freely and comfortably right round each set of boilers. Elaborate coal conveying apparatus is always used, but strange to say in the large central stations of the Berliner Elektricitats Werke hand firing is in vogue.

At the Luisenstrasse station in Berlin, and also in the station of the elevated railway, the boilers are placed immediately over the engines, so that piping is reduced to a minimum, the real reason, however, for this arrangement is the great expense of land. It is interesting to note that the German equivalent to the English Board of Trade has made it a rule that no boiler may be placed under any structure other than its own roof.

The engine rooms of the modern German central stations, particularly those in Berlin, at Moabit and Oberspree, and also at Wiesbaden, have been built on a magnificent scale, and are lavishly decorated with glazed brickwork, handsome tiled floors, etc. As a rule, the engine room is high enough for the crane to swing the heaviest castings quite clear of the big machinery, and this, of course, adds to the imposing appearance. High-speed engines are entirely absent, and each low-speed unit has so much space round it, that just about double the amount of plant could be put into the station. From this readers may judge that the standing charges for rates, taxes and interest on foundations and buildings are very high. The contrast with the crowded English stations, filled as they generally are, with high-speed engine plant, is very marked.

The Sulzer, Goerlitz, Collman, and other horizontal engines, which were seen, excited much admiration, not only on account of the splendid proportions and finish, but also because the engines worked so quietly. There is no doubt that in the matter of valve and governor gear for slow-running engines the continental makers have nothing to learn.

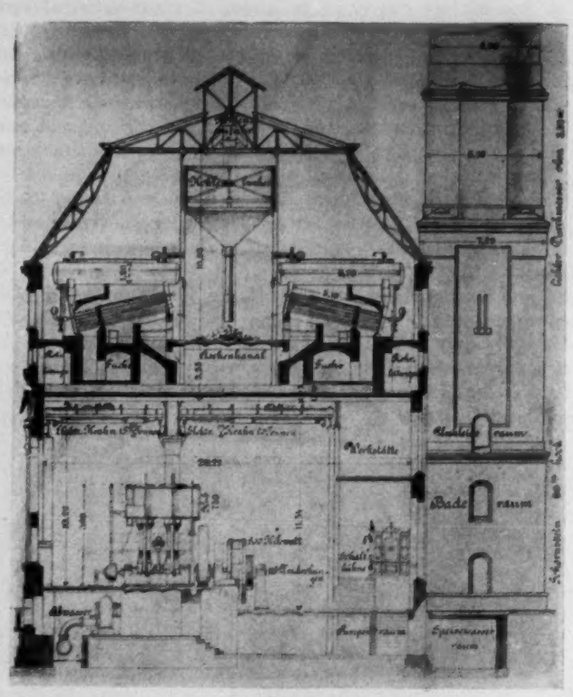


FIG. 2.—CROSS-SECTION POWER STATION, BERLIN ELEVATED AND UNDERGROUND RAILWAY.

Very large storage batteries are installed in some of the stations, as, for example, in Hanover. In successful accumulator manufacture, Germany may fairly be said to take the lead, and this is a

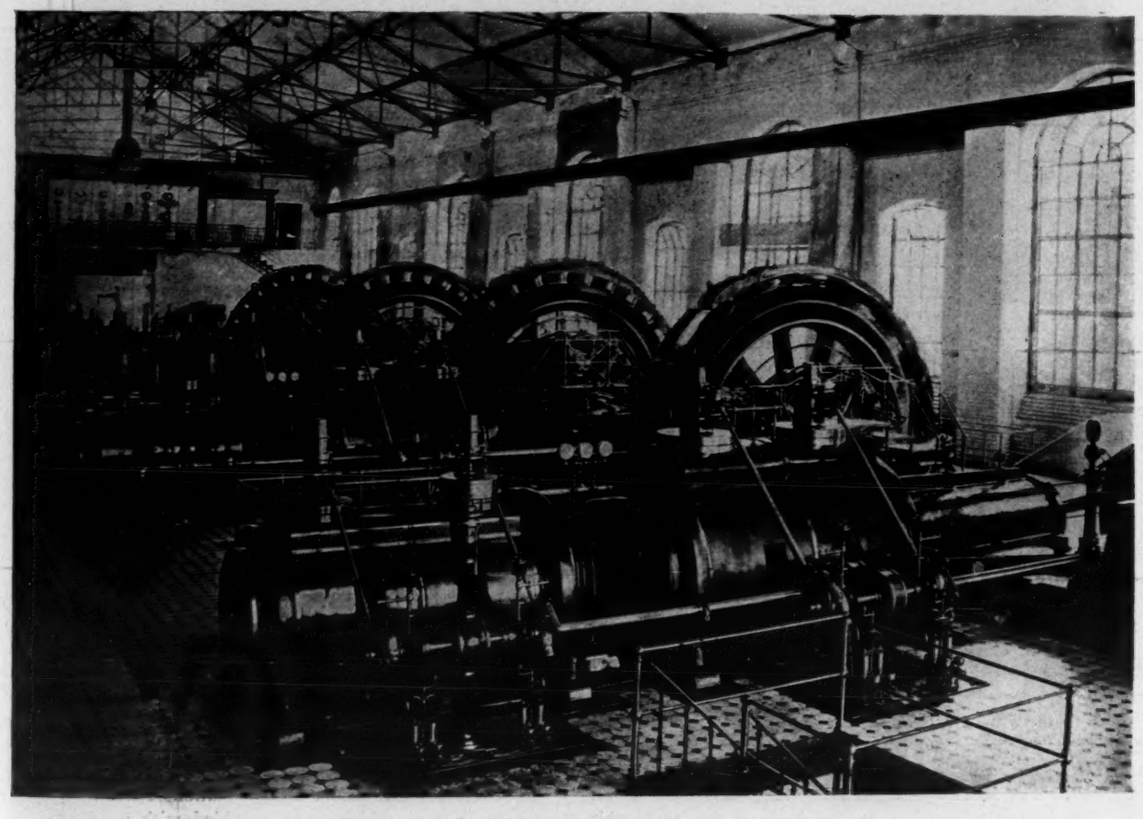


FIG. 1.—GENERAL VIEW DRESDEN CENTRAL STATION.

good deal due to the success of the Tudor and Hagen cells, and also to the fact that the Germans appear to have recognized the fact that to keep an accumulator battery in proper order it is well to have at least one member of the station staff who is an expert in their manufacture. They do not believe in leaving the battery entirely to the tender mercies of ordinary engine driver or switchboard attendant.

In all the modern engine rooms piping is entirely out of sight, the steam ring or header being, as a rule, arranged vertically on the boiler house side of the wall, and the branch pipes to each engine carried under the engine house floor. This arrangement (the very opposite to English practice) is highly satisfactory, as it reduces the risk of accident, and enables the designer to lay out and ornament the engine rooms on the grand scale which is so characteristic of German central station work.

Coming now to the dynamo machinery, it was interesting to note how many of the old type Siemens & Halske machines are still in use, and also how well they worked. The stationary inner pole machine with a Gramme armature having its outside conductors developed into a commutator has undoubtedly done good work. Even so modern a station as that recently equipped for the Berlin Elevated Electric Railway has this class of machine, the only difference being that it has a separate commutator. (This commutator, by the way, had been erected without having been turned up.)

Regarding the standard multipolar dynamos, there is not much to be said, as all machines nowadays are very similar in design. The pole pieces of most machines were specially shaped, some as in the Schuckert machine being skewed. Some of the machines had brushes only to those poles about the horizontal diameter, which were easy to get at. Combination carbon and gauze brushes are commonly employed, and nearly every machine had a means of lifting all the brushes together when required. Generally speaking, the commutation of the various makes of dynamos was quite beyond criticism, for although most brush rockers were provided with means for ready adjustment, it did not appear to be ever required.

In several instances special efforts were made to keep the commutator cool, etc.; the dynamos, for example, in the Luisenstrasse station in Berlin are fitted with a small electrically-driven air blast to remove the coper and mica dust from the armature, and some of the Lahmeyer dynamos have slots cut right through the segments to allow air to circulate through the commutator from the inside. At the Homburg central station two dynamos are coupled to the same engine, one being of large diameter, to act as a flywheel.

With regard to the alternators, it would appear that the inductor type of machine has dropped out of use. The machine usually employed has a stationary armature and revolving field, each pole having its own coil. The largest and probably the finest alternators, are those of 2500 kilowatts supplied by the A. E. G. to the Moabit and Oberspree central stations inspected by the visitors from England.

As a rule, the armature frame casting is made very heavy and massive, there being a good deal of choice in the actual section employed. There are cases, however, as in the Schuckert machines in Nuremberg central station where the armature frame is made of light section, the necessary stiffness being obtained by radial tie rods, as in the machine which the company showed at the recent Paris Exhibition.

At first sight this light construction appears to be open to much criticism, but when one considers that the problem is very similar to that of a bridge there is much to be said in its favor. At any rate, it is interesting to find the A. E. G. adopting a somewhat similar method for its largest type alternators. The company are now building up their armatures with two side castings and stiffen them with tie rods having right and left-hand screws. Besides cheapening of manufacture and transport the reasons put forward are that it is possible to adjust the air-gap to a much greater nicety, and the armature stampings being exposed on their outer periphery have a better chance of cooling.

The Ferranti edgewise winding for the poles is practically universal, and in some cases the edge of the copper was turned up for appearance sake. In almost all the machines which had solid cast steel poles, the flange of the magnet coils nearest the pole piece is made of very heavy section gun metal. When the poles were laminated, as in the case of A. E. G. machines, damping coils are employed, which consist simply of solid copper rods passed through pole pieces and short-circuited at the ends.

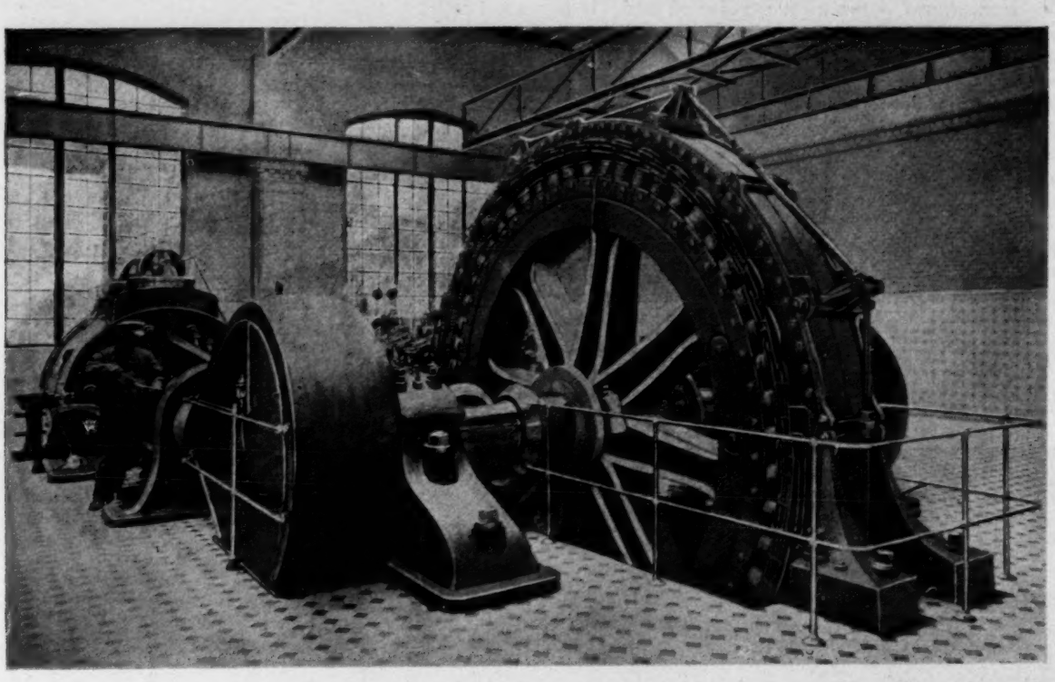


FIG. 3.—THREE-PHASE ALTERNATOR.

Frankfort is an interesting station, because, although a single-phase station, it has a motor load of over 5000 horse-power, including the motor generators for driving the city tramways. The eight alternators in this station are by Brown, Boveri & Co., and they have armature rings which can be revolved when necessary for inspection or repair. The barring engine can be used for turning, either the flywheel or the armature ring. In order to get the engines into synchronism, the flywheel is fitted with a contact piece, which at each revolution makes contact with a projection on the armature ring and so may be made to ring a bell.

The sub-station for the Schiller Platz has four 250-kw synchronous motors driving 500-volt traction dynamos, and there is also a buffer battery and an arc lighting switchboard. It is the largest underground sub-station in the world, and credit is due to the original engineer of the Frankfort station, G. J. Mehns, formerly with the Thomson-Houston Company, for carrying out so fine a job. Single-phase motors are used for all manner of work, including the driving of lift elevators direct.

In several of the Berlin central stations special rotary converters were to be seen which were provided with an alternating-current

booster on the three-phase side. The arrangement is such that by adjusting the field current in the poles of the booster the voltage on the direct-current side can be accurately adjusted within very wide limits, for example, the pressure may be raised high enough to charge batteries.

In the matter of high-tension switches and fuses the German practice is perhaps not as far advanced as one would have expected. Oil break switches and fuses which have been so successful in America and also in England do not appear to be employed in Germany at all.

Some of the switchboards equipped by the A. E. G. have a special carriage type switch, in which the switch contacts are mounted on insulators on a four-wheeled trolley and the break is made by running the truck back.

Fuses are nearly always of the cartridge type, the wires being contained in glass tubes and buried in a refractory material, such as marble dust, powdered mica or talc. When the voltage is extra high, wooden tongs are provided so that the fuse can be removed with less risk of accident.

One of the switches shown to the visitors is worth mentioning on account of its simplicity. It consists merely of a Siemens & Halske horn lightning arrester, fitted with a metal plug at the bottom, where the horns approach each other. In switching off, the plug is withdrawn and the arc then runs up the curved horns until it has a length of several meters, and so is unable to maintain itself. It has been said that when an arc is allowed to persist in this way there is a heaping up of voltage which is dangerous, but, on the other hand, there is a distinct risk to the insulation in making too sudden a break.

The inaccessibility of the switchboard platforms was a matter of some surprise, for the platforms were either fitted with a spiral staircase from the engine room or they were approached from a staircase at the rear. One station engineer explained this by saying that they did not want the switchboard attendant to leave his post nor to make it easy for the engine attendant to go on to the switchboard platform.

As a rule, the back of the switchboard was not shown on account of its being considered too dangerous.

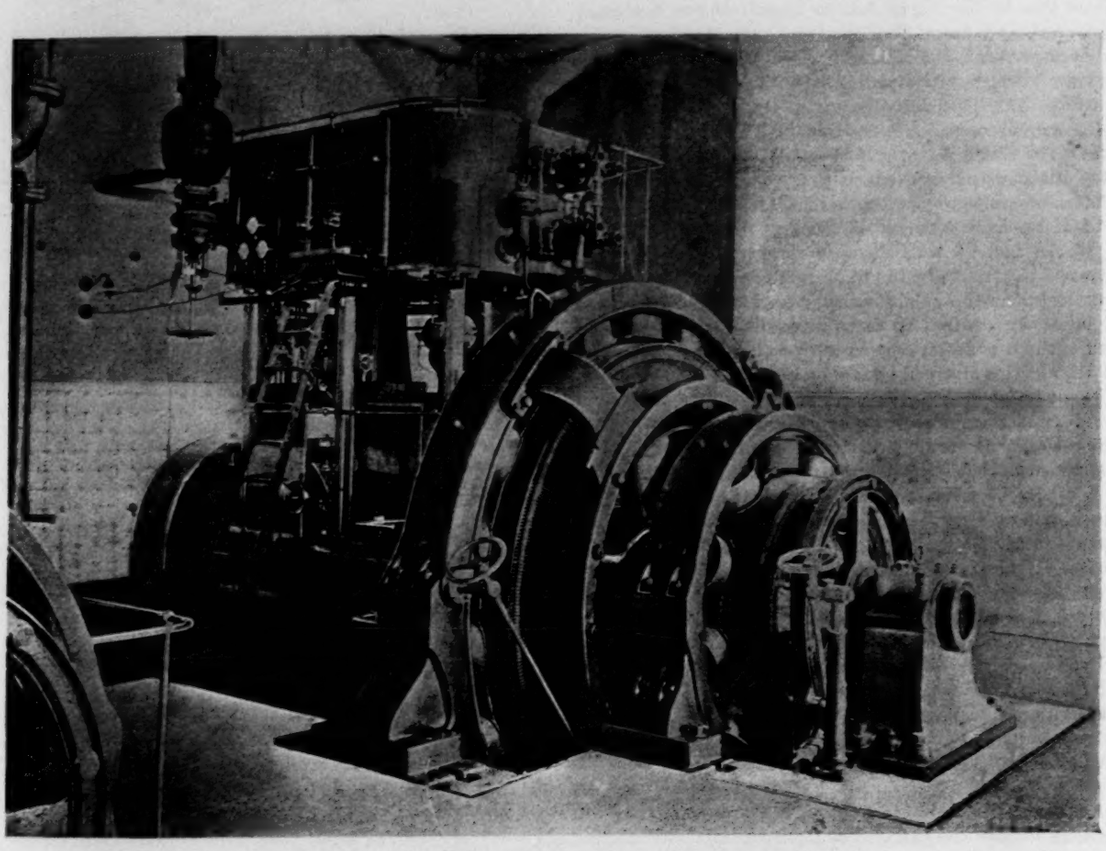


FIG. 4.—DIRECT-CONNECTED UNIT, HOMBURG ELECTRICITY WORKS.

The Situation in Independent Telephony.

Following is a copy of an announcement sent to the stockholders of the Federal Telephone Company, of Cleveland, Ohio: "The independent telephone situation was never in as good condition in every way as it is to-day. The completion of the work that is now in course of construction, namely, the exchanges at Alliance, Canton, Dayton, Findlay, Mansfield, Springfield, Zanesville, and several smaller exchanges in Ohio, together with Detroit, Jackson, and other important points in Michigan, and the main line of the United States Telephone Company connecting Michigan, West Virginia, Kentucky and Pennsylvania with the present system in Ohio, will make one of the most complete telephone systems in the country, which is a combination of strength not equaled by any other property in existence. (1) On account of the various business interests represented. (2) The property is practically all new and modern. (3) The number of subscribers reached is much greater than that of our competitor. (4) The rates are reasonable and always have been, therefore the public is and will continue with us.

"In addition to the work above described, other companies are pushing the development rapidly in nearly every section of the United States from Boston, Mass., to Seattle, Wash. In order to complete certain new properties we have decided to offer to our present stockholders in addition to their present holdings, the following securities to be designated as Federal Telephone Company, Pool A; payments to be 50 per cent, Aug. 20; 25 per cent., Sept. 1, and 25 per cent Sept. 15, with interest at 6 per cent from the date of payment, to Jan. 1, 1902, all balance to bonds to draw interest in favor of pool holders, from Jan. 1, 1902.

	Bonds.	Stocks.
Findlay Home Tel. Co.	$80,000	$24,000
Citizens' Tel. Co., Fostoria.....	45,000	13,500
Columbiana County Tel. Co...	220,000	66,000
Zanesville Tele. & Tel. Co.....	160,000	48,000
Lancaster Tel. Co.	45,000	13,500
	$550,000	$165,000

"For each $900 paid into Pool A the subscribers will receive a receipt of the Federal Telephone Company entitling them to $1000 bonds and $300 stock bonus in the above named companies.

A Long Electric Railway in Massachusetts.

By Alton D. Adams.

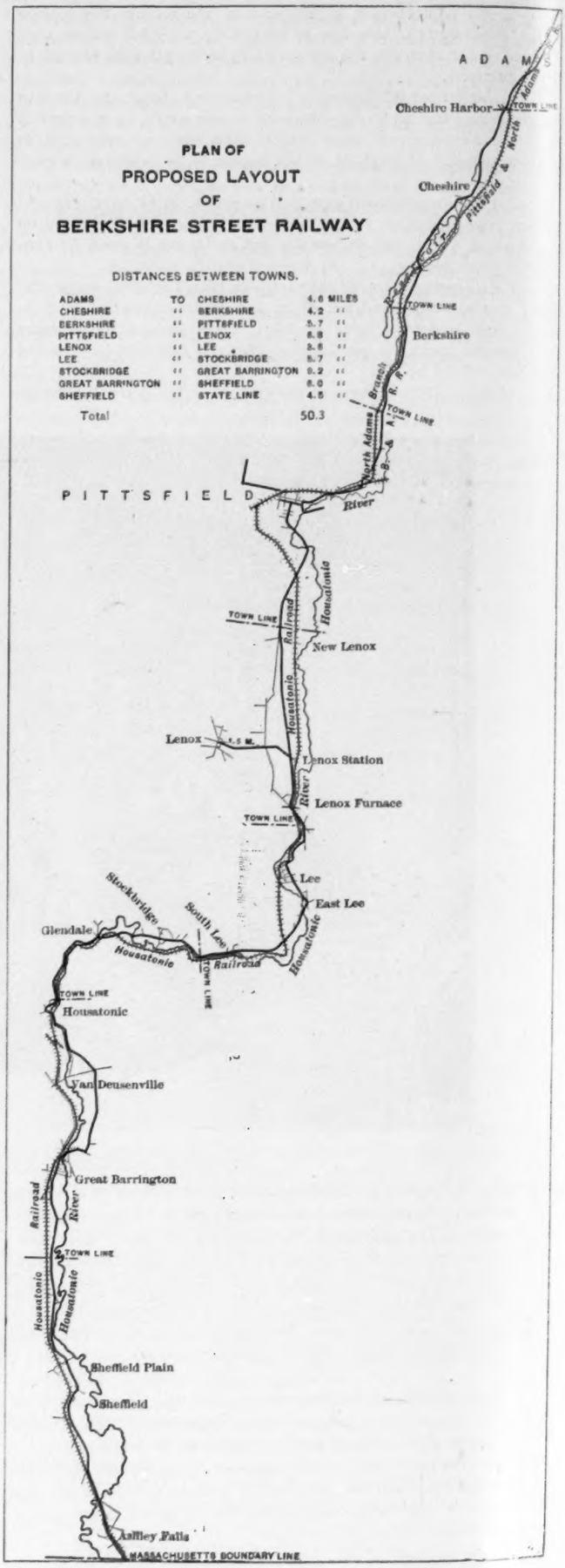
SOME interesting railway work has just been inaugurated in Massachusetts, under a contract for the construction of such a line between Great Barrington and Cheshire, by the way of Pittsfield, Lenox, Lee, Stockbridge and Housatonic, in the heart of Berkshire County.

This contract, which has just been let to Fred T. Ley & Co., of Springfield, Mass., for the sum of $675,000, covers only the construction of the track and electric lines of the road, and calls for their completion in not more than four months from July 22, 1901, under a forfeit of $100 per day for any excess of this period, and a bonus in a like sum for each day by which completion precedes the required date.

The contract for the equipment of electrical machinery necessary for this railway is still pending, but will be closed very shortly. From Cheshire to Pittsfield the general course of this railway will not be far from that of the North Adams branch of the Boston & Albany steam road, and from Pittsfield to Great Barrington the valley of the Housatonic River and the tracks of the Berkshire division of the New York, New Haven & Hartford Railway, represent the approximate route. The entire length of the Great Barrington & Cheshire Railway is 42 miles, consisting of a single main track with turnouts. At Cheshire, connection will be made with the Hoosac Valley Electric Railway, which runs to North Adams and Williamstown, thus completing a continuous line from the northwest corner of Massachusetts to within about 15 miles of the southern boundry of the State, a total distance of about 58 miles. The Great Barrington & Cheshire road is to be located for approximately one-half of its length in the public highway, and for the remaining half on a right of way owned by the company. The road will be ballasted with 2 ft. of gravel along its entire course, and standard steam railway ties of chestnut will be laid on centers of 2 ft. Seventy-lb. steel rails will be used throughout for the track, and these will be double bonded to serve as the only return conductor, no supplementary wire or ground feeders being provided. Twenty steel bridges are included in the contract for the construction of the road. Two trolley wires, each of No. 4-0 hard copper, will be strung over the single track, and will serve as feeders along a large part of its length. One advantage of the two trolley wires is that the use of turnout switches at sidings is thereby avoided. The overhead construction is to be mounted on side brackets, except in the centers of the towns, and will be suspended from chestnut poles. Two circuits of three wires each will extend from Pittsfield through Lee, and on to Housatonic. At Pittsfield the steam-driven electric generating station for the road will be located. This station is to be provided with two alternating generators, each three-phase, with a capacity of 750 kilowatts at 12,000 volts. Besides this generating station, there will be two sub-stations, one at Lee, and the other at Housatonic. The generating station and each sub-station will be provided with transformers and two rotary converters, each rotary having a capacity of 300 kilowatts. Each transformer will receive current at 12,000 volts and deliver it to the rotary converter that will supply the trolley line with direct current at 550 volts.

The two circuits of three wires each from the generators at Pittsfield to the sub-stations at Lee and Housatonic, will both connect to the transformers in each sub-station, so that either circuit may supply energy to either rotary. Approximate distances between the places named are Pittsfield to Cheshire, 13 miles; Pittsfield to Lee, 15 miles; Lee to Berkshire, 10 miles, and Berkshire to Great Barrington, 4 miles. Dividing the spaces equally between the adjacent groups of rotary converters, the rotaries at Pittsfield must supply the line 13 miles to Cheshire on the north, and 7.5 miles, or one-half way, to Lee on the south. The rotaries at Lee must supply 7.5 miles to the north and 5 miles, or one-half way, to Housatonic on the south. At Housatonic the rotaries feed back on the line 5 miles, and on to Great Barrington, a distance of 4 miles. The Great Barrington and Cheshire line will be started about Dec. 1 with seven cars. Each car is to be 45 ft. in length, and equipped with motors of 200 horse-power. Between Cheshire and Great Barrington the regular running time is to be 1.75 hours, so that the average speed for the 42 miles is 24 miles per hour. Each car is designed, however, to make 40 miles per hour when desired.

This electric railway is not only the first rural and interurban line



MAP OF ROUTE OF BERKSHIRE RAILWAY.

in Massachusetts to adopt the polyphase system, but it is also believed to be the longest line that has ever been built as a single interurban system in the State. Steam railways, paralleled by this electric road, depend on local travel for their earnings to a very large extent, and the competition of the street cars will probably prove to be a very serious matter for them. As Massachusetts law provides that not more than 5 cents may be charged by street cars for transportation of a passenger through or in any one town, the possible fare on the new electric line seems limited to 30 or 35 cents from Cheshire to Great Barrington, a rate of less than 1 cent per mile. This, of course, will cut much below the average steam railway fare, but the projectors of this interesting line are quite confident that even at such a low rate they can make the investment a good one.

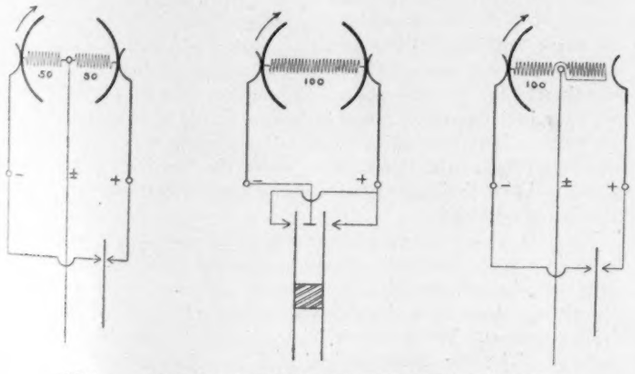
Telephone Magnetoes for Delivering Pulsating Current for Selective Signaling.

BY NORMAN H. HOLLAND.

WHILE the records at the Patent Office disclose the fact that over 400 patents have been taken out on selective signaling devices and kindred apparatus, yet with the exception of those which operate by means of difference of polarity, there are comparatively few "individual call" systems in operation. It would appear that whereas in the early days, considerable experimental work was done in this direction on a practical scale, since the introduction of the bridging method of connection, selective signaling has been allowed to rest. When it was found that by means of connecting the ringing coils in multiple, we could obtain a party line circuit which contains qualities that would allow efficient ringing and good talking—the prime requisites—the advantages of selective calling were considered secondary and given up when they would seem to entail as a necessary attendant complicated apparatus at the substation. The ease with which four signals can be operated between the two sides of a metallic circuit and the ground by means of using only currents in different direction, has made that form of individual calling on party lines quite popular; and there are increasing numbers of such systems daily being put into use.

Simpler forms of these polarity systems require very little additional attachment, either at the sub-stations or exchange, to that employed on the usual bridging line. The ringer, however, is usually provided with a spring which retains it when at rest always on one side, and the magneto generator, which is of ordinary construction, is provided with a commutator so as to deliver a pulsating current in one direction.

There are three different ways in which the winding of a magneto generator can be connected to the commutator in order to deliver a direct current, and I show the three methods in the following diagrams: The crescent shaped, heavy black lines in the diagrams, are meant to represent the periods in the revolution of the armature in which a current is generated. As is well known, an ordinary Siemens' "H" armature has two portions of its revolutions in which no current is generated. These correspond to the interval in which the armature shoes are completely covered by the pole pieces. These intervals of no current are represented in the diagram by breaks in the heavy black circle.



FIGS. 1, 2 AND 3.—MAGNETO FOR SELECTIVE SIGNALING.

Referring to Fig. 1, the winding represented is that in which the winding is connected to the frame at its central point and an equal amount of wire wound on each half of the armature, the outer ends of each coil terminating respectively at each commutator segment.

Fig. 2 represents also a double segment commutator. In this, however, the winding is not grounded at all, and current is taken from between the inner and outer brushes.

Fig. 3 represents a commutator with just a single segment. The writer believes the third method of connecting is the most preferable and that it will be found the best suited for operating selective signals. The fault with the method of connecting in Fig. 1 is that whereas the current is taken from the frame and either of the outside wires, just half the number of turns are active at any one time. Therefore, an armature having a sufficient number of turns to develop 100 volts, if connected the same as that in Fig. 2 at the same speed and even conditions, only 50 volts would be developed by the generator as connected in Fig. 1.

Fig. 2, while using the total number of turns at each impulse requires a double-throw pole-changing switch to change from positive to negative. Fig. 3 delivers at maximum voltage, as every turn of the wire is utilized, while a single-pole switch will change from positive to negative.

There is another consideration, however, which is important, besides that of utilizing all the wire and convenience in changing the polarity of the circuit. It will be understood by comparing the three diagrams that with the two segments shown in the winding of Fig. 1 and Fig. 2, twice the number of impulses will be given at the same speed as there would be in Fig. 3. In this, the third method again shows its superiority over either of the others. In a generator having a permanent magnet field, the voltage or pressure varies almost directly as the speed. It would seem, therefore, that gearing up the generator as high as possible would be a distinct advantage. In practice, however, it is soon found that when the speed in the armature has reached a certain point it delivers so rapid an alternating current that the bell hammer will not follow, requiring a definite time for the armature to change its direction and move from one pole to the other. In Fig. 3 we approach more nearly those conditions which prevail when using the generator to deliver alternating current in actuating a centrally pivoting polarized armature. If an alternating current is supplied to the line, the bell is first pulled on to one side by the current of a certain direction, the reversing of the current pulling the bell back to the other side.

In Fig. 3 the current from the single segment pulls the bell over to one side, allowing the spring to restore it during that period in which no current is generated in the armature, thus allowing the same amount of time for the armature to be pulled over by the spring as is given for the current to pull it over. It will be seen that the spring would have to act to restore the armature between the impulses of both commutators if the generator is wired according to Fig. 1 or Fig. 2. In practice, this means that unless the generator is turned quite slowly, the armature of the bell will not respond properly. Thus, to get the same time for the bell hammer movement it would be necessary to rotate generators No. 1 and No. 2 just about one-half as fast as you could turn No. 3, the result being a corresponding drop in voltage, so that if you could get 100 volts from an armature connected as in Fig. 3, under equal condition of field and winding it would only be practical for you to get a little over 50 volts from a magneto wound and connected as shown in Fig. 2, or about 25 volts from a generator wound as in Fig. 1.

The voltage of the generator delivering pulsating current of this kind if connected, as shown either in Fig. 2 or Fig. 3, reaches just as high a maximum as if the same winding were delivering the usual alternating current. This has been questioned often because of the fact that you can ring more alternating bells through a given resistance than you can those which are arranged to operate by pulsating direct current. This is not, however, due to the inferiority of the strength of the generator, but to the retarding influence of the spring used on selective bells, which, of course, the pulsating current has got to overcome. It is sometimes the case that generators with commutators for delivering direct current are placed on bridging lines, not with any intention to make the system for selective signals, but merely so it will be impossible for the different parties on the line to ring one another, and can only drop the target at central. Sometimes the ringers on such lines are not equipped with springs. It is, however, very much better to use springs to retain the armatures on every bell in the circuit all on the same pole (north or south, as the case may be) as otherwise some of the stations may be annoyed by a single tap at the bell every time a subscriber rings central.

The Development of the Nernst Lamp in America.[1]

BY ALEXANDER JAY WURTS.

IT was in 1897 that Mr. Henry Noel Potter, while in the employ of Mr. Westinghouse, at Goettingen, became acquainted with the Nernst lamp. Early in 1898, Dr. Nernst, Mr. Potter and an assistant came to East Pittsburg at Mr. Westinghouse's request and exhibited the new discovery. Mr. Westinghouse quickly recognized its great possibilities and directed the writer to prepare for its commercial introduction. A happy choice brought Mr. Marshall W. Hanks to my assistance. Mr. Potter returned to Goettingen to study some of the details of the work. In June, 1899, Mr. Edward Bennett joined us, as did also Mr. Frederick M. Goddard a month or two later, who had been assisting Mr. Potter in Germany, but unfortunately in December of that year Mr. Goddard contracted a violent cold from which he never recovered. In February, 1900, Mr. Murray Charles Beebe joined us, and in August of the same year, Dr. Max von Recklinghausen.

I have thus briefly introduced the characters who have worked upon the Nernst lamp in America, and without whose names its history would be incomplete; my only regret being that these gentlemen are not all present on this occasion to share in the pleasure of announcing to the American Institute of Electrical Engineers the results of our work upon the Nernst lamp.[2]

THE GLOWER.

It is not my purpose to describe the details of our experiments, but rather to give the results of our work. Let us begin with the glower, so named to distinguish it from the filament of the incandescent lamp.

Our standard 220-volt glower is about 25 millimeters long and .63 of a millimeter in diameter. It is made by expressing from a die a dough made of the rare earths mixed with a suitable binding material, cutting the porcelain-like string thus made into convenient lengths, drying, roasting and finally attaching lead wires. This sounds very simple, but the making of glowers is an art not easily acquired; it is the result of long and painstaking investigation, particularly with reference to the terminal connection between the glower and lead wire. This connection, as Dr. Nernst made it, consisted of a few turns of platinum wire wound around each end of the glower, the convolutions being finally pasted with cement. This forms a successful and effective terminal, but the shrinkage of the glower ends, away from the convolutions of platinum wire sometimes causes the contact to deteriorate, resulting in the weakening and early destruction of the glower near the terminal. In the Hanks terminal, these conditions are reversed. A platinum bead is embedded in the end of the glower in such a manner that any tendency to shrink on the part of the glower material can result only in tightening the contact and thereby maintaining intimate union between the platinum bead and the glower. It is, then, a simple matter to fuse lead wires to the embedded platinum beads.

The glower, as you all know, is a non-conductor when cold, becoming, however, a conductor when heated. It is also an electrolyte; but it may be fairly stated that this phenomenon is not clearly, if at all, understood. Oxygen, however, seems to be necessary, or at least desirable, for its successful operation. As might be expected, no electrolytic action is apparent when operating with alternate current. With direct current the electrolytic action is quite marked, resulting in a black deposit on the negative end of the glower, which spreads gradually from the negative toward the positive terminal. As this deposit increases, the voltage of the glower changes somewhat, and the candle-power and efficiency fall off, owing to the poor light-emitting properties of the blackened portion. The life of the glower on alternating current is about 800 hours; with the same glower on direct current, it is considerably less than this. There are, however, radical improvements being made in direct-current glowers.

A glower burns at a higher efficiency in its own heat, that is, in a globe, than it does in the open air. We shall refer again to this feature in connection with the multiple glower lamp. The glower is about as strong as a piece of porcelain of the same size, and it is difficult to break a short section. The terminals of a glower give off platinum black, which deposits on the globe; and although this cannot be wiped off with a cloth, it is easily removed in a variety of ways, so that the globe may be considered a permanent fixture in the lamp, and, for that reason, may assume fancy designs. When properly made, the voltage of a glower changes but slightly during its life, the tendency being to rise from two to four per cent in 800 hours. For a short time before rupture, the voltage rises rapidly until the glower is broken.

The characteristic of a glower with reference to voltage and current is remarkable, and has given rise to the necessity of a steadying resistance. As the current in the glower is increased, the voltage across its terminals rises, at first rapidly, and then more and more slowly to a maximum, beyond which it again drops off with increasing rapidity as the current and resulting temperature through the glower continue to increase. Beyond the point of maximum voltage, the decrease in resistance of the glower is so rapid as to make the current difficult of control; in fact, without a steadying resistance, such a conductor would rapidly develop a short-circuit and flash out. The characteristic of a Nernst glower is shown in curve 1 (Fig. 1), the small circle situated near the crest of the curve representing the point of 1.76 watts per candle in the open air.

In studying the characteristics of the glower and seeking for methods of operation under the best possible conditions, we naturally exploited the field in various gases, including a vacuum, and although the experiments in this direction have not been exhaustive from a scientific standpoint, the results have been negative as far as practical results are concerned, and have demonstrated that for the present, at least, there is nothing to be gained in this direction. The vacuum curve and corresponding air curve are shown in Fig. 1.

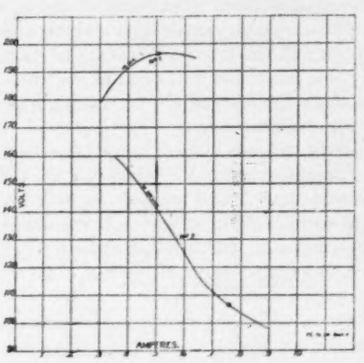


FIG. 1.—VACUUM AND AIR CURVES.

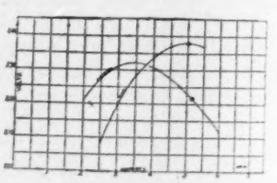


FIG. 2.—NITROGEN AND AIR CURVES.

Aside from the fact that the vacuum has shifted the point of 1.76 watts efficiency to a much lower voltage and higher current density, it will be observed that all the points of the curve now lie on one side, giving a decreasing difference of potential for an increasing current. Such a condition as this involves the use of a relatively large steadying resistance, and renders the operation of the glower inefficient. Fig. 2 shows the nitrogen curve with corresponding air curve, and it will be observed, as in the case of the vacuum, that this gas has also rendered necessary a large steadying resistance and has thereby lowered the available efficiency of the glower. In Fig. 3 we have both the oxygen and hydrogen curves to compare with the air curve. It is interesting to note how closely the oxygen and air curves compare with each other, while the hydrogen curve shows characteristics similar to that of the vacuum curve requiring a large steadying resistance.

There is an interesting phenomenon connected with glowers operating in a space free from oxygen, and which seems to be especially pronounced when operating in a vacuum. Where oxygen is excluded the glower seems to be sluggish and to respond but slowly to changes in line voltage. The curves in Fig. 4 show this sluggish action in a vacuum. The line voltage is indicated by a dotted line in the upper part of the diagram, beginning with 270 volts. The upper solid curve shows the change of current value during a lapse of time indicated in minutes; while the lower curve shows the change in voltage on the glower during the same interval. Previous to this test, the glower had been run at .25 of an ampere for half an hour, after which the

[1] A paper read before the American Institute Electrical Engineers, Buffalo, Aug. 23, 1901.

[2] EXPLANATORY NOTES.—The Hefner nuit of candle-power has been adopted in this paper, so that ready comparisons may be made with results obtained on the Nernst lamp in European countries.

Names of Parts in the Nernst Lamp: The "glower" is the filament or light-giving body. The "ballast" is a steadying resistance connected in series with each glower. The "holder" is the removable piece containing glowers and heaters. The "heater-porcelain" is the porcelain disk in the holder immediately back of the heater. The "heater-case" is a small glass globe used in the six-glower and thirty-glower lamps.

line voltage was raised 20 volts and the current values and differences of potential on the glower were taken at intervals for 10 minutes, resulting in the curves shown. Shortly after the completion of this test, the line voltage was lowered 20 volts, when the glower again adjusted itself slowly to the new conditions, and returned to

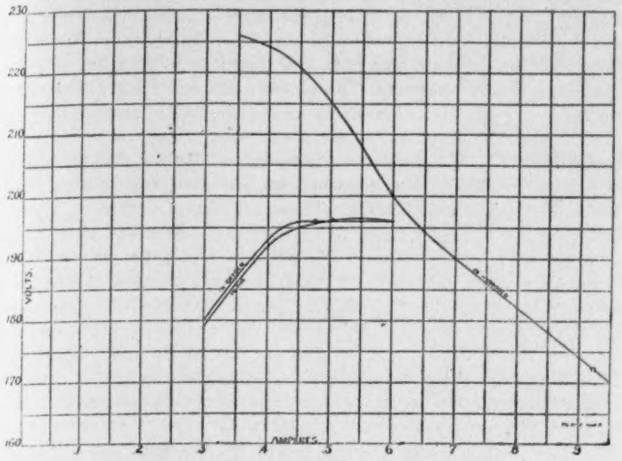


FIG. 3.—OXYGEN, HYDROGEN AND AIR CURVES.

its original current and difference of potential. In air, the glower would have responded almost immediately to similar changes in line voltage. It is likely that the slight changes in both cases after the first minute are largely, if not entirely, due to the temperature correction of the resistance that was connected in series with the glower.

STEADYING RESISTANCE OR BALLAST.

The advantage to be gained by the use of a steadying resistance which would enable the glower to be operated efficiently at a point on or beyond the crest in the characteristic curve, was well recognized. To accomplish this under all conditions of commercial use, and with as little loss as possible under normal conditions, the steadying resistance should have as large a positive temperature correction as possible and this temperature correction should always be immediately available. For example, if the glower were operated on or beyond the crest of the characteristic, the current could obviously be controlled by a sufficiently large steadying resistance having no temperature correction, but such resistance would very ma-

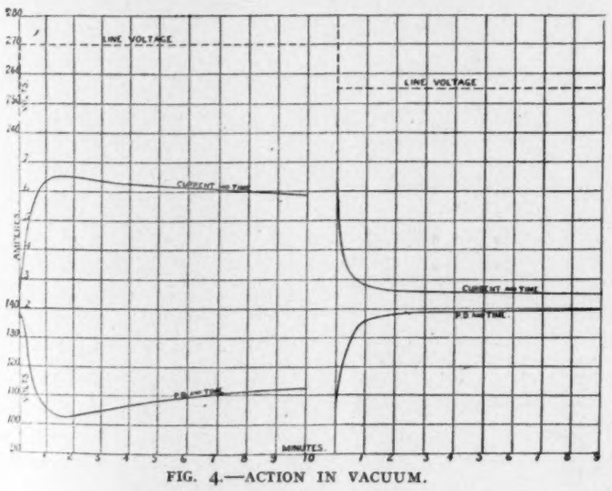


FIG. 4.—ACTION IN VACUUM.

terially decrease the net efficiency of the glower. On the other hand, if the resistance is assumed to have a high temperature correction, the necessary steadying resistance under normal conditions may be very much less than when no temperature correction is present, and then should there be an increase in e. m. f. above normal, the corrective power of the steadying resistance would be brought into play to check any abnormal flow of current through the glower; in other words, to take up the additional voltage; but, as already stated, the temperature correction should be *immediately* available, for if it were not, the glower would "shoot over" when lighting above the normal pressure, that is, take more current at the start than it would a little later after the temperature correction of the steadying resistance had asserted itself. The same would also be the case with any sudden increase in the e. m. f. applied to the glower unless the corrective power of the steadying resistance were immediately available to check the current flow.

Mr. Potter has designed a steadying resistance or "ballast," as he has named it, which is certainly unique in construction and which meets in a very effective manner, the peculiar requirements of the glower. Iron wire is used on account of its high temperature correction, and by properly mounting this in a small glass tube filled with some inert gas, he has secured a ballast having at once a high corrective power with minimum resistance at normal, and oxygen being entirely excluded, the wire can readily be worked throughout the entire high corrective region without danger of destruction. This remarkable characteristic of the ballast is well shown in Fig. 5, from which it will be noticed that for a 10 per cent rise in current

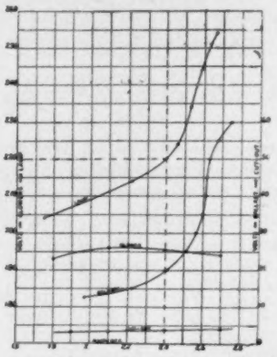


FIG. 5.—CHARACTERISTIC OF THE BALLAST.

the resistance of the ballast increases 150 per cent, so that a glower thus protected becomes at once operative throughout a wide range.

THE HEATER.

As already stated, the glower is a non-conductor when cold, becoming, however, a conductor when heated. For practical service in a lamp, therefore, it is necessary that some means be provided for heating the glower and bringing it to a conducting temperature. This topic could well form a subject by itself, but time will permit me to review but briefly the developments made in this direction. Some of the lamps which Dr. Nernst brought with him from Europe were fitted with electric heaters, while others were intended to be heated by an alcohol lamp or even a match. The further refinements of the lamp imposed new and severe requirements upon the heater. It is therefore especially gratifying that we can announce the construction of a simple, satisfactory and effective heater, suited to the requirements of the latest forms of the lamp. The glower is lighted at a temperature of about 950 degs. C., and it will be readily apparent that to acquire such a temperature quickly and without rapid destruction of the heater and adjacent parts renders the section of the materials a very serious problem. Platinum for the heater seems like an undesirable expense in a commercial lamp, and although many attempts have been made to devise a cheap mineral heater, platinum still holds its own as the least expensive, the most durable, and altogether the most desirable material for this purpose; and, after all, the expense is not so serious, because when the platinum heater is burned out, the value of the scrap is nearly 90 per cent of the original cost, and as the labor is almost negligible, the running cost of the heater is small.

As now constructed, the heater consists of a thin porcelain tube overwound with a fine platinum wire pasted with cement, the latter serving as a protection to the platinum wire from the intense heat of the glowers. These tubes are wound for 110 volts, and are connected in pairs of two in series, according to service, the one, two and three-glower lamps taking one pair, and the six-glower two pairs. These heater tubes are mounted on a porcelain support in such a manner as to afford easy access for repairs without removing the glowers. The life of the heater when running continuously is about 200 hours, or 133 hours when the current is turned on and off 4000 times at regular intervals. Inasmuch as the heater is not called into service for more than about 30 seconds to light the glowers, this would indicate a practically infinite life. In actual service, however, the heater remains in close proximity to the glowers and the high temperature to which it is thereby subjcted causes a material decrease in its life. Nevertheless, the life of the heater is surprisingly

long, probably several thousand lamp-hours. The exact time, however, cannot be definitely determined until a large number of lamps have been operated over a very considerable period in general commercial lighting.

CUT-OUTS.

An automatic lamp requires a cut-out to disconnect the heater from the circuit as soon as the glower shall have lighted. This is another one of those details that Dr. Nernst developed and exhibited in some of his early lamps, but which we have sought to still further perfect and to adapt to the special types of lamp which we have constructed. The cut-out involves a coil, a moving member and a contact, all of which must function at a temperature of about 110 degs. C. without possibility of failure. The coil must therefore be heat proof, the contact must not weld, and the moving member should not hum on alternating current. These requirements are severe, but they have all been met in a most effective and satisfactory manner by embedding the coil in cement, by making the contact of silver, and by suspending the moving member from a single point of support.

The latter feature of the cut-out is illustrated in Fig. 6; 1 is the

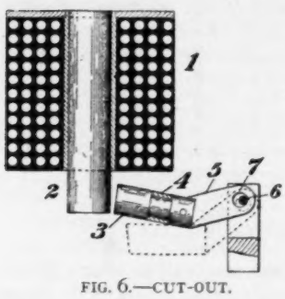


FIG. 6.—CUT-OUT.

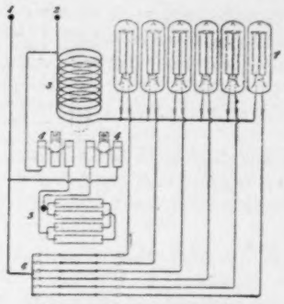


FIG. 7.—CONTACT PRONGS.

coil, 2 the core, 3 the armature or moving member, which is round in section; 4 is a silver band, which makes contact by gravity with two silver wires not shown, forming a V; 5 is a strip of sheet steel .007 of an inch thick, which is inserted into the armature and securely held by a pin; 6 is a small steel rod or support for the armature, and 7 is a hole in the steel strip 5, somewhat larger in diameter than the pin 6, so that when the armature is attracted by the magnet, there is practically only a single point of contact between the strip 5 and the supporting pin 6. This construction has resulted in a cut-out which entirely avoids the humming sound so persistent in the ordinary types of alternating-current apparatus.

LAMPS.

The lamps thus far developed are indicated in the following table:

Candle-Power.	Voltage.	No. of Glowers.	Style.
50	110	1	Indoor
50	110	1	Outdoor
50	220	1	Indoor
50	220	1	Outdoor
100	220	2	Indoor
170	220	3	Indoor
400	220	6	Indoor
400	220	6	Outdoor
2000	220	30	Indoor

The main features are the same in all. The indoor lamps are provided with ornamental spun brass housings; the outdoor lamps with neat japanned cast-iron housings. Single glower lamps have single pole cut-outs, whereas all the multiple glower lamps are provided with double pole cut-outs, the reason for this difference being that the extremely high temperature in the immediate neighborhood of a number of glowers tends to establish leakage currents between the glowers and heaters, unless the latter be entirely disconnected from the circuit.

We will examine in detail the six-glower lamp as typical of all the others. This lamp is suspended from an eye-bolt which, being removed, allows of immediate access to the inner parts. On removing the housing, we find that the ballasts are placed in a semi-circle around the cut-out, the arrangements of the parts being such as to make all easy of access. The connections are made with small aluminum plugs on the ends of the interconnecting wires which avoid the many familiar inconveniences associated with set screws. All the parts are mounted on porcelain; in fact, there is no combustible material whatever in the lamp. The heaters and glowers are attached to a removable piece or "holder," the design being such that the heaters backed by a porcelain disk are immediately above the glowers, resulting in the following advantage: Stagnation of heat from the heater, thereby lighting the glowers in minimum time; no shadows, nearly all the light being thrown downward where it is ordinarily most desired; stagnation of heat from the glowers whereby the latter are run in their own heat and therefore at a higher efficiency than they would otherwise. The glowers and heaters are attached to the binding posts of the holder by means of small aluminum plugs, so that the perishable members are always easily and conveniently interchangeable. The holder is provided with nine contact prongs, which, when the holder is pushed up into the lamp, automatically make the desired connections. These are shown in Fig. 7; 1 and 2 represent the line terminals; 3 the actuating coil; 4 and 4 the double pole cut-out; 5 the heater; 6 the glowers, and 7 the ballasts, there being, of course, one ballast for each glower. A small glass globe, called the "heater-case," is held by spring clamps around the glowers, the function of which is to retain the heat and thereby decrease the time of lighting as well as increase the efficincy of the glowers. In service, the "heater porcelain," which is the porcelain disk immediately above the heater, becomes coated with a thin layer of platinum black, unless measures are taken to prevent it, and this not only decreases the illuminating power of the lamp, but if not removed, will in course of time become conducting and cause leakage of current. No simple means have been discovered for removing the platinum black from the porcelain surface. This difficulty, nevertheless, has been avoided by coating the surface of the porcelain with a thin layer of white paste, which may be easily removed with a stiff brush or scraper. The platinum black now deposits on this coating, both of which may be removed together, leaving the fresh, white surface of the original porcelain to be recoated for further service; but even should the platinum black be allowed to accumulate, all danger of leakage currents is avoided by surrounding the holes through which the lead wires pass, by small annular rings or grooves, it having been discovered that the platinum black will not deposit in these small spaces; the continuity of the platinum black surface between the lead wires is thereby interrupted. For higher candle-powers, the six-glower holder is used as a unit, and this may be multiplied to any desired limit.

The quality of the light is remarkable for its beauty and close ap-

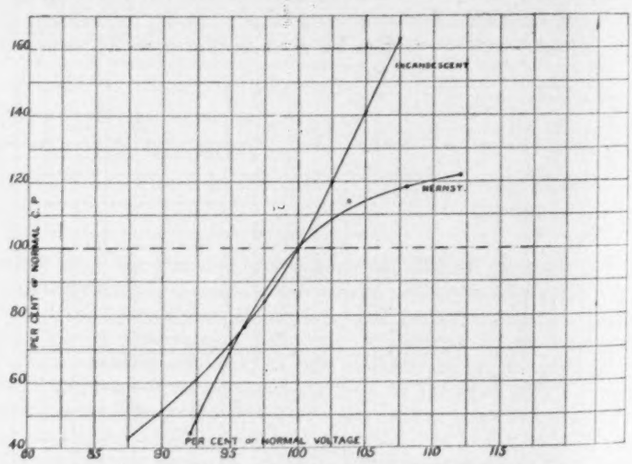


FIG. 8.—CURVES OF INCANDESCENT AND NERNST LAMPS.

proximation to daylight. All colors are seen in their proper shade, making the light especially desirable in stores, art galleries, drawing-rooms and the like. The absence of shadow, the steadiness of the light, the simplicity and low cost of maintenance, the high efficiency of the lamp, and the fact that it is operative on 3000 alternations, are features that will commend themselves strongly to the lighting world.

EFFICIENCY.

It is not an easy matter to state the efficiency of a light, and the difficulties are especially pronounced in the case of the Nernst lamp. It would seem desirable, therefore, to give the results of various methods of measurement and comparison rather than to make any definite statement based on any particular method or set of read-

ings. Referring, therefore, to the six-glower, 220-volt, alternating-current lamp, from which most of the data has been obtained, we may note the following:

A 220-volt glower operating at its normal current of .4 of an ampere, requires 20 volts more in the open air than when burning with five other glowers in a three-inch globe. The lower voltage and consequent better efficiency, when using multiple glowers in a globe, is due to the fact that the glowers are operating in a highly heated atmosphere. The efficiency of the six-glower lamp with clear heater case, but without the dome shade, is 1.2 watts measured in the direction of greatest intensity.

A more satisfactory statement will be found in the accompanying table giving the spherical and lower hemispherical efficiencies of the six-glower Nernst lamp, together with the corresponding figures of alternating-current and direct-current enclosed arc lamps:

					Mean Intensity in H. U.						Watts per Mean H. U.					
					Spherical.			Lower Hemisphere.			Spherical.			Lower Hemisphere.		
	Voltage.	Current.	Watts.	Power Factor.	Opal Outer.	Clear Outer.	Shade.	Opal Outer.	Clear Outer.	Shade.	Opal Outer.	Clear Outer.	Shade.	Opal Outer.	Clear Outer.	Shade.
6-Glower.	220	2.35	517	1.0	149*	—	147	240*	—	279	3.47	—	3.5	2.15*	—	1.85
A. C. Arc.	110	6.29	417	.6	130	159	152	—	190	254	3.21	2.62	2.49	—	2.23	1.48
D. C. Arc.	110	4.9	539	1.0	177	207	—	—	272	—	3.03	2.60	—	—	1.98	—

An opal inner globe or heater-case was used in all cases except the four readings marked *.
*A clear heater-case and sandblasted spherical globe were used.

The arc lamp figures were taken from the report of the Committee for Investigating the Photometric Values of Arc Lamps, read before the National Electric Light Association in May, 1900. Examining this table, it will be noticed that the spherical efficiency of both arc lamps is better than that of the Nernst. In the lower hemisphere, the Nernst is somewhat better than the alternating-current arc, and not as efficient as the direct-current arc. When reflecting shades are used, the alternating-current arc again has a slight advantage for the whole of the lower hemisphere; but if we disregard the mean of the lower hemisphere and consider the floor or desk illuminating power of the lamp, we find that the Nernst lamp has a very decided advantage over the enclosed alternating-current arc; for example, if we consider the mean of the lowest 30 per cent zone, the efficiency of the enclosed alternating-current arc is 1.56 watts against one watt for the Nernst and the mean of the lowest 60 per cent zone is for the enclosed alternating-current arc, 1.45 watts against 1.23 watts for the Nernst.

Comparisons between the illuminating powers of the Nernst and incandescent lamps indicate a watt consumption in the Nernst lamp a little less than half of that in the incandescent for equal illumination. The superior quality of the Nernst lamp is also very marked both for reading purposes and for the correct determination of color.

A similar comparison between the illuminating power of the Nernst and enclosed alternating-current arc lamps shows for an equal consumption of watts in the two lamps, a much superior floor illumination for the Nernst lamp, slightly better general illumination for the arc lamp; but the quality and steadiness of the Nernst light, together with the entire absence of shadow, give an impression of decided superiority in favor of the Nernst.

The two sets of curves, Figs. 8 and 9, show interesting comparisons between the Nernst and incandescent lamps under conditions of varying voltage. Fig. 8 shows the relative change in candle-power and Fig. 9 the relative change in efficiency, all the variations in each case being given in per cent of normal conditions. These curves are self-explanatory, except as to the remarkable steadiness of candle-power in the Nernst lamp when forced above normal voltage. The feature is due to the great corrective power of the iron ballast.

At present our data regarding the effect of running Nernst lamps at different efficiencies is rather limited. Figures of this character require many readings under all kinds of conditions, and it may be some time before these can be satisfactorily and definitely recorded, but, roughly, it may be stated that the efficiency of he glowers falls but slightly during their natural life, whereas the decrease in lamp efficiency will be affected to a considerable extent by the care and attention which the lamp receives.

PERFORMANCE OF THE LAMP.

At the present writing, July 15, we are operating at East Pittsburg, 73 six-glower lamps, one three-glower and three single-glower; in our laboratory and shop at Allegheny, 40 six-glower, 10 three-glower, and 21 single-glower lamps; in the courtyard we have four outdoor six-glower lamps, and in the tumbling room of the foundry, one outdoor six-glower lamp, all running on alternating current at 220 volts. In addition to these, there are 14 single-glower direct-current 110-volt lamps in Mr. Westinghouse's residence, making a total of something like 50,000 candle-power in and about Pittsburg. At the Pan-American Exposition, we have lighted the interior of the dome of the Electricity Building by festooning 92 six-glower lamps from a pendant chandelier consisting of a central lamp of 30 glowers and 2000 candle-power encircled with six lamps of the six-glower type; on the floor, variously distributed, there are 12 six-glower, 24 three-glower and eight one-glower lamps. These figures are intended to give some idea of the scale on which the Nernst lamp has been developed and the resources which have been placed at our disposal.

Seventeen six-glower lamps have been running at East Pittsburg for more than a year, and are now showing an average life of 800 hours per glower. A similar record has been made with 14 six-glower lamps operating in Allegheny for about a year and a half. The four outdoor six-glower lamps have been running every night during the last 12 months through all kinds of weather, and up to the present time have not given a moment's trouble. The six-glower lamp in the tumbling room of the foundry failed in the cut-out at the end of 1000 hours, owing to the accumulation of a bunch of iron dust on the pole of the cutout magnet, but a few strokes of a brush removed the difficulty and the lamp was continued in service.

The line service to these lamps has been fairly good for a shop circuit. As a matter of record, however, it was decided to test four six-glower lamps on the city lighting circuit, noted for its poor regulation and to keep a record of the service and the lamp performance. The record follows:

Four six-glower, 220-volt lamps were run 1000 hours on the regular circuit of the Allegheny County Light Company. The run was continuous with the exception of three periods per day of one-half

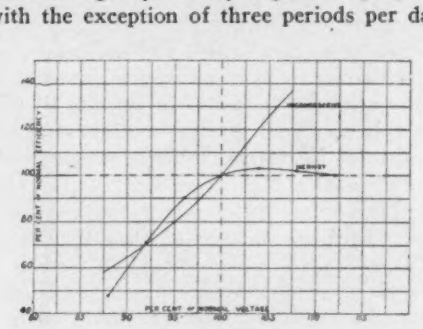


FIG. 9.—CURVES OF INCANDESCENT AND NERNST LAMPS.

hour each when the lamps were turned off. A record of the voltage was kept with a Bristol voltmeter. An inspection of the voltmeter cards show that these may be classified under three types. Of the first, there were 15 cards, indicating that the voltage did not rise higher than 229 volts and only remained there for a short period. Of the second type, there were 26 cards, in which case the voltage reached a maximum of 232 volts, maintaining this for about four hours. Of the third type, there were four cards showing a rise of voltage to 237 and remaining at 235 for five hours. These cards show that the lamps have been tested on a circuit, pressure of which varies from 4 per cent below to 7½ per cent above normal. There were no ballasts or heaters burned out during this run, nor did the lamps receive any attention or give any trouble.

Of the 24 glowers in these lamps

15 ran 1000 hours;
6 ran 792 hours;
1 ran 580 hours;
2 ran 380 hours;

making an average of 890 hours.

The three, two and one-glower 220-volt, alternating-current lamps have given equally satisfactory service, but the glowers in the 110-

volt alternating-current lamp are not quite so uniform in their performance and the same glowers on direct current are comparatively short lived, averaging in the neighborhood of 150 hours; 220-volt glowers, however, on a direct-current circuit would last nearly double that time. At East Pittsburg, where a section of the factory about 350 ft. long is lighted with 50 six-glower lamps suspended immediately above the traveling cranes, the features which strike one more forcibly than anything else are the beauty of the illumination and the total absence of shadow and flicker so intimately associated with the electric arc illumination in places of this character.

In connection with this topic, it will be interesting to note just what is going on in the lamp during the time of lighting, also during

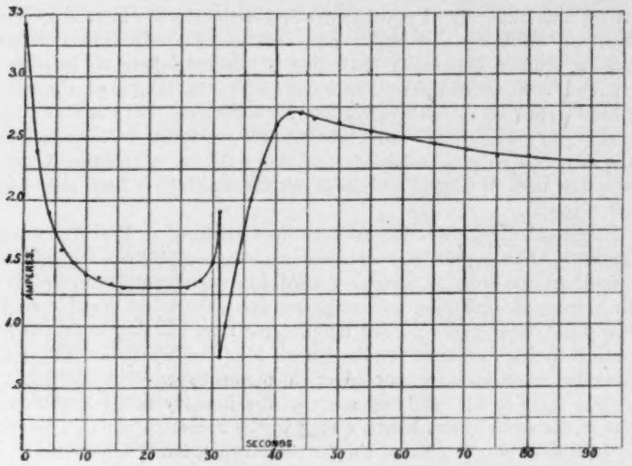


FIG. 10.—CURRENT CURVE OF SIX-GLOWER LAMP.

service under varying conditions of line voltage. Referring to Fig. 10, we have a curve showing the current taken by a six-glower 220-volt lamp during the lighting period. It will be noticed that as the current is turned on, there is a sudden rush of nearly 3.5 amperes through the heater, which, owing to the temperature correction of the platinum wire, is quickly reduced to about 1.3 amperes. At the end of 26 seconds, the first glower begins to light; at the end of 30 seconds the second glower is lighted and the heater is cut out, the current dropping at once to .75 of an ampere; the remaining glowers then light rapidly until at the end of 40 seconds all the glowers are lighted. From this point on, there is a slight drop in the current until the lamp reaches its normal running temperature.

Referring once more to Fig. 5, we find the current and voltage characteristics of the different elements in the lamp, and above these the characteristics of the lamp itself, the latter being the sum of the cut-out coil, the ballast and the glower. The lamp curve was taken from actual measurements and approximates very closely to the sum of the elements, the slight difference probably being due to some differences of temperature. The voltage scale for the cut-out and ballast curves will be found on the right-hand side of the diagram; that of the glower and lamp on the left-hand side. Your attention

FIG. 11.—HEATER TUBES AND GLOWERS.

is now directed to the excellent characteristic of this lamp, and when we consider the severe conditions imposed by the glower characteristic, I think we are to be congratulated on the results which have been attained. With a normal in the lamp of 2.4 amperes and 220 volts, it will be noticed that an increase of 14 per cent in voltage causes but a 10 per cent increase in current, resulting in a comparatively steady light and safe running conditions for the lamp in commercial service. A rise of 25 per cent in the line voltage would burn out the ballasts in a very short time, but a rise of 10 per cent for short periods does not seriously affect the life of either glower or

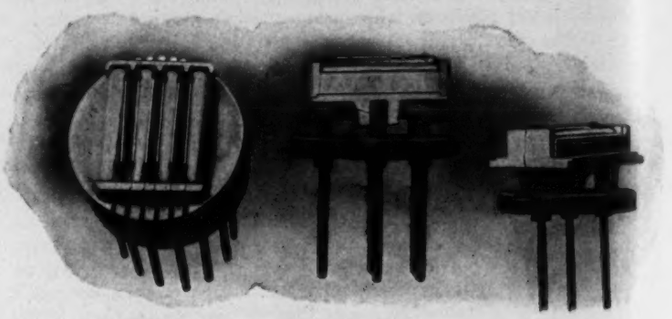


FIG. 12.—HOLDERS FOR THE SIX, TWO AND THREE, AND ONE-GLOWER LAMPS.

ballast; a rise of 5 per cent may be considered allowable for indefinite periods.

REPAIR AND MAINTENANCE.

When the lamps are first started, they require no attention. After 1000 hours, however, the renewals become fairly regular, and our

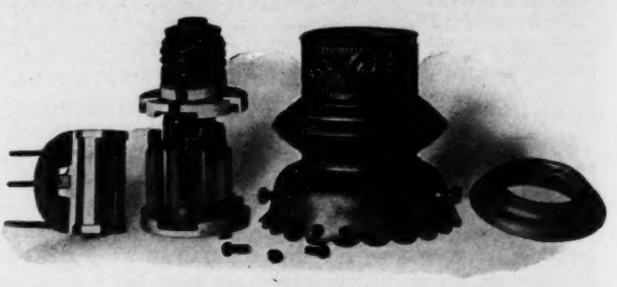


FIG. 13.—PARTS OF SINGLE-GLOWER LAMP.

experience shows an average life of 800 hours for the glowers, 2000 to 3000 hours for the heaters and an indefinitely long life for the ballasts. It will, however, be some time before the average life of the heaters and ballasts can be definitely determined. The attention which these lamps receive, consists in having the inspector examine the lamps once a week through a colored glass to determine whether or not all six glowers are burning. If two glowers are out, the lamp is turned off, the holder removed and two new glowers inserted; the holder is then returned to its place and the lamp continued in service. Aside from such renewals, these lamps have not given the least trouble.

FIG. 14.—TWO AND THREE-GLOWER LAMP, INDOOR TYPE.

FIG. 15.—SIX-GLOWER LAMP, INDOOR TYPE.

On the occasion of starting up 50 six-glower lamps at East Pittsburg, one of the engineers who had had considerable experience with

FIG. 16.—METHOD OF GRIPPING HOLDER.

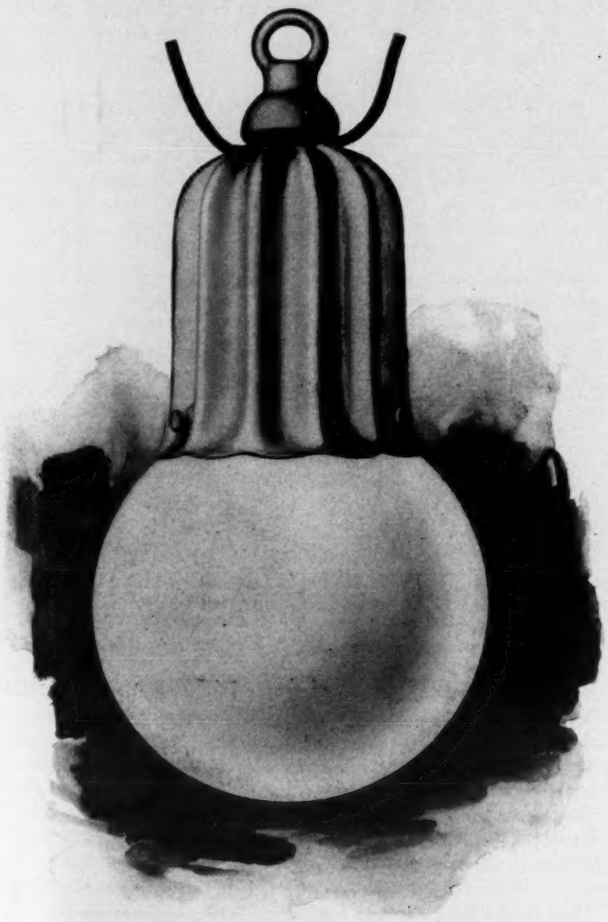


FIG. 17.—THIRTY-GLOWER LAMP, INDOOR TYPE.

arc lamps, remarked that my troubles would now begin; but, frankly, I think he was mistaken. Aside from the renewal of the perishable parts, I see nothing in the lamp which could possibly cause trouble except under the most extraordinary circumstances; in fact, should a lamp receiving proper attention fail to light, I would look for the trouble elsewhere than in the lamp.

In commercial service it is intended that the central station shall make the renewals in the holders. The customer will be provided with a case containing a suitable number of complete holders, ready for service, so that when a renewal is to be made, the customer will simply remove the old holder and insert a new one, such operation consuming but a moment's time; then, at convenient periods, the old holders will be exchanged for new. Where lamps are used in quantity, the renewals will probably be made by the local attendant. The replacing of a ballast requires the removal of the lamp from the circuit, but after that the renewal is easily and quickly made. A slight withdrawal of one screw releases the ballast tube from its socket, whereupon the small aluminum terminal plugs may be withdrawn and the new ballast inserted. This operation does not require any tools other than a pair of small tweezers, and the renewal can be made without returning the lamp to the work-bench.

FIG. 18.—SIX-GLOWER LAMP, OUTDOOR TYPE.

After about 100 lamp-hours, the heater case becomes somewhat discolored, and, for first-class maintenance, this should be cleaned at the end of that time. The following instructions for the care and inspection of the Nernst lamps are observed at East Pittsburg:

Inspection of the Lamps.—The lamps should be inspected every 100 lamp-hours. After being turned off, the lamp is turned on, and it is noted whether all the heater tubes become bright. If any of the heater tubes are burned out, the holder is replaced by a new one.

If the heaters are intact, the number of glowers burning is determined. If five or six are burning, the lamp needs no attention.

If less than five glowers are burning, the lamp is to be turned off, the holder taken out and the number of broken glowers determined by inspection. If the number of broken glowers is less than the number of glowers that were out, one or more ballasts are out of order and the lamp is to be taken down at once and the defective ballast replaced. When two or more glowers are burned out, the holder is to be replaced by a reserve holder.

Ballasts.—These are supplied in boxes marked "Ballasts for six-glower lamps," "Ballasts for one-glower lamps," etc. Burned-out

ballasts are to be renewed as soon as discovered and may be replaced without taking the lamp to the work-bench.

Heater-Case.—This receives a coating of platinum black on the inside and should be replaced every 100 lamp-hours by a clean heater case. The coating may be removed from the old heater case with a bristle brush running at a high rate of speed. The heater case may then be used over again.

Glowers.—These are supplied in glass tubes marked with the voltage of the lamp for which the glower is intended, thus, "Glowers for 220-volt, six-glower lamps." Glowers marked for six-glower, are not to be used in a three or one-glower lamp, and vice versa.

Heaters.—These are wound for 110 volts and are so marked. They are connected two in series for 220 volts. In the six-glower lamp there are four tubes connected in multiple series.

Heater Porcelain.—(This is the porcelain disk immediately behind the heater.) The heater porcelain is given a white coating, which becomes fairly hard, but can be easily scraped or brushed off when it becomes covered with platinum black. When a holder with a black heater porcelain is removed, the glowers should be taken out, the old coat brushed off, except directly under the heater tubes, and a new coat of "heater porcelain paste" applied. The paste is a white powder which is to be mixed with water and applied with a camel's-hair brush. After replacing the heater porcelain and allowing it to dry in the air, run the heater for two minutes on 220 volts, placing the holder in a heater case. This hardens the coating, after which the glowers may be replaced.

FIG. 19.—SINGLE-GLOWER LAMP, INDOOR TYPE.

Cost.—It is too early to say anything definite about the cost of these lamps. Fourteen or fifteen dollars would seem to be a fair price for a six-glower lamp, other lamps in about the proportion of the number of glowers. It is estimated that the cost of renewals will be considerably less than for enclosed arc lamps. Provision will be made for the return of the perishable parts containing platinum.

CONCLUSION.

In closing, let me say that the Nernst lamp can in no sense be considered an experimental device. The development of details connected therewith has continued until all question of doubt as to its commercial success has been removed by the operation of a large number of lamps of various sizes and finished pattern for extended periods under commercial conditions, and it is confidently felt that the splendid exhibit of these lamps, which may be seen at the Pan-American Exposition, will prove a fitting demonstration of the complete and thorough manner in which the brilliant discovery of Dr. Nernst has been taken up and pushed forward in America.

Seventh Annual Convention of the Ohio Electric Light Association.

THE seventh annual convention of the Ohio Electric Light Association was held at Hotel Victory on Put-in-Bay Island, Ohio, on Aug. 20, 21 and 22, 1901, under the presidency of Mr. E. J. Bechtel, of Toledo, Ohio. An attractive programme was presented, the papers being of great excellence, and a lively interest was taken in the discussions. The business sessions opened Tuesday afternoon with an excellent address by the president, E. J. Bechtel, of the Toledo Traction Company, reviewing the work of the Association in the past, and indorsing the proposed system of uniform accounting, and recommending the admission of representatives of the manufacturers and supply houses as associate members. This recommendation was referred to the executive committee, and later favorably reported by them, and adopted by the association as an amendment to the constitution.

Mr. W. D'A. Ryan, of the General Electric Company, read a paper on the "Relative Merits of Open and Enclosed Arc Lights for Street Illumination," printed copies of which appropriately illustrated, were distributed to those present. This paper attracted general attention, and was very favorably commented upon. The discussion of it was participated in by Messrs. White, Dow, Scovil, Thulen, Bechtel, Rust, Perkins and Turner. Mr. Ryan has for the first time attempted to illustrate the value and inherent variations of electric light and the causes thereof. The luminometer, an instrument invented by him, makes it possible to investigate the relative merits of various globe combinations, and also the relative lighting distance of various sized units with a degree of accuracy far exceeding, it is said, anything heretofore deemed possible or attempted.

At the night session Tuesday Mr. Lehman B. Hoit, of the Bullock Electric Manufacturing Company, showed lantern slides illustrating recent improvements in the construction of alternating and direct-current apparatus, and also the application of direct-current machines for operation of various classes of machines, and explained the economy in the use of the multiple voltage system of control. The system, as described, dispenses with the use of rheostats for controlling the speeds of machines to which the motors are directly connected. The saving over the rheostatic control, the speaker stated, where there is desired a variation of speed, is about 90 per cent.

Mr. M. E. Turner, of the Cleveland Electric Illuminating Company, presented a paper on "Selection and Maintenance of Meters for Measurement of Electric Current." Mr. Turner has always been a valued contributor to the literature of the Ohio Association, and was listened to with attention. The paper was followed by discussion.

At the Wednesday morning session letters of regret were read from Messrs. G. N. Clapp, of the Washington C. H. Gas & Electric Company, and George Matt, executive committeeman, of the Lancaster Electric Light Company.

Mr. Clarence Renshaw, of the Westinghouse Electric Manufacturing Company, read a paper on "Suburban Electric Railways, Particularly with Relation to Central Stations." The paper was discussed.

On Wednesday afternoon a paper was presented by Mr. J. Henry Hallberg, of the General Incandescent Arc Light Company, New York City, in which he gave in detail and quite impartially a résume of the principal methods for controlling alternating-current arc lamps in series on constant-potential circuits, demonstrating that the reactive coil system in connection with the shunt lamp possessed the most points of advantage to central stations. In connection with the paper was furnished a complete set of plates which illustrated in a diagramatic way the various methods of connection and control for circuits of the kind mentioned.

Mr. H. C. Wirt, of the General Electric Company, presented an interesting paper on transformer designs, bringing out quite strongly the essential qualities, such as insulation, core loss and regulation, showing the effect of the latter on the life and candle-power of incandescent lamps. The paper covered an experience of the last 13 years in transformer manufacture. Interesting data was given as to the life and durability of modern transformers as compared with transformers made several years ago. Important recommendations were made as to the desirability of manufacturers and stations establishing voltage and frequency standards, so that data tables could be compared without necessity for correcting them for uniform voltage. At present some tables are based on 2000-volt primary, and others at 2080 volts. It was urged that 2080 volts be the standard voltage, in view of the fact that the majority of central stations are operating at primary voltage at transformer terminals of 2080 volts, or higher, requiring the use of 104-volt lamps. A few stations on the other hand, employ the use of 100-volt lamps. It is important that manufacturers give attention to the requirements of insulation and temperature rise of transformers. It was suggested that in comparing the economical operation of transformers the yearly cost, which should include interest and depreciation, power consumption should be made the basis of comparison. Electrical efficiencies alone, independent of the cost, should not be taken as a guide as to the merit of the different designs.

New members admitted were the following: The Port Clinton Electric Light & Power Company, Charles E. De Witt, president; the Northern Ohio Traction Company, L. E. Beilstein, general manager, Akron, Ohio; the Shawnee & Straitsville Electric Light Company, S. N. Poston, secretary-treasurer, Nelsonville, Ohio; the New Lexington Electric Light Plant, T. J. Smith, proprietor, New Lexington, Ohio; the People's Gas & Electric Company, W. P. Engel, Defiance, Ohio, president.

Mr. D. L. Gaskill, of Greenville, read a very important paper on "The Relation of Electric Light Companies to Municipalities from a Legal Standpoint," which was considered a valuable contribution, and elicited considerable discussion.

Mr. Gaskill stands for the furnishing of the best and most efficient service, and the taking of the public into the confidence of station managers, believing that a liberal policy is the best from every consideration.

Mr. Gaskill has given considerable thought to this subject, and his opinions coming from a legal authority, are always given weight.

The first business of the Thursday morning's session was election of officers and selection of place of meeting. The following reported by the nominating committee were unanimously elected, viz.:

President, W. F. White, Cincinnati; vice-president, E. H. McKnight, Middletown; secretary-treasurer, J. H. Perkins, Youngstown. Executive Committee: H. C. Fogle, Canton; S. M. Rust, Piqua. Finance Committee: W. F. Raber, Mansfield; L. H. Thulen, Leetonia; F. E. Valentine, Urbana. Advisory Committee: D. L. Gaskill, Greenville; A. W. Field, Columbus; Samuel Scovil, Cleveland. The association is to be congratulated upon its choice for president of one of the progressive electric light men of the country, who is establishing a national reputation. Columbus, Ohio, was selected as the convention city in 1902, on the invitation of Mr. A. W. Field.

Mr. E. S. Pillsbury, of the Wagner Electric Manufacturing Company, St. Louis, gave a paper on "Single-Phase Alternating-Current Motors," illustrated by diagrams.

Several topics were then taken out of the "Question Box," and freely discussed.

After adopting suitable resolutions of thanks to the various essayists and others who had contributed to the instruction and pleasure of the convention, the convention adjourned sine die, the date of the next meeting to be hereafter fixed by the executive committee.

The ladies' entertainment was looked after by Mr. Emil G. Schmidt, of the Sandusky Electric Light Company, who personally conducted an excursion around the Islands on Wednesday morning, also a visit to the Caves. Mesdames Bechtel, Perkins, McKnight and daughters, Scovil, Valentine, Hoit, Renshaw, Douds, Field and Gaskill were of the party.

The following were in attendance upon the convention: E. J. Bechtel, Toledo Railways & Light Company; A. W. Field, Columbus Edison Company; D. L. Gaskill, Greenville Electric Light & Power Company; W. F. Hubbell, Wauseon Electric Light & Power Company; E. H. McKnight, Middletown Electric Light & Power Company; J. H. Perkins, Youngstown Gas & Electric Company; John M. Plaisted, Columbus Electric Company; W. F. Raber, Citizens' Electric Railway, Light & Power Company, Mansfield; S. M. Rust, Piqua Electric Company; Emil G. Schmidt, Sandusky Electric Light Company; Samuel Scovil, Cleveland Electric Illuminating Company; T. J. Smith, New Lexington Electric Light & Power Plant; L. H. Thulen, Leetonia Electric Light & Power Company; F. E. Valentine, Urbana Electric Light & Power Company; Alex. Dow, Edison Illuminating Company, Detroit; F. J. Alderson, Stanley Instrument Company, New York; Perry R. Boole, Electric Appliance Company, Chicago; H. B. Coles, G. I. L. Company, Cleveland; F. C. Colwell, G. I. A. L. Company, Cincinnati; Chaw M. Crofoot, Pass & Seymour and Crouse-Hinds Electric Company, Cincinnati; H. J. Douds, G. E. Company, Cincinnati; Robert E. Gorton, N. Y. & Ohio Company, Warren, Ohio; J. H. Hallberg, General Incandescent Arc Light Company, New York City; W. J. Hanley, G. E. Company, Cincinnati; Lehman B. Hoit, Bullock Electric Manufacturing Company, Cleveland; Wagner Electric Manufacturing Company, St. Louis; H. E. Hull, Erner-Hopkins Company, Columbus; F. M. Knierim, the F. Bissell Company, Toledo; Charles S. Kuntz, Post-Glover Electric Company, Cincinnati; Ray D. Lillibridge, New York; W. G. Nagel, the W. G. Nagel Electric Company, Toledo; Ernest J. Paradis, the W. G. Nagel Electric Company, Toledo, and F. G. Vaughen, H. C. Wirt, W. D'A. Ryan, all of the General Electric Company.

Telephone Lines for Farmers.

In a letter to Mr. H. B. Gates, secretary of the Indiana Mutual Telephone Association, at the recent annual meeting, discussing the demand of farmers everywhere for telephone service, Mr. George W. Beers, of Fort Wayne, said:

In view of the demand for telephones by farmers, your toll or county lines should be built after the best engineering methods, employing only the best of materials. Poles 30 and 35 ft. in length should be used, equipped with 10-pin cross-arms, braced to the poles, the poles should be spaced about 132 ft., using 40 to the mile on straight lines, and more as needed on corners and turns. They should be sunk at least one-sixth of their length, those poles on corners and turns should be double-armed and thoroughly stayed and guyed, according to the service required. Nothing but copper wire should be used, and not more than five stations on any one circuit.

Your farmer subscriber will have greater need for the long-distance lines than your city residents, and therefore his line should be equal in all respects to those used in your exchange. Your farmer is indebted to the independent exchange owner for his telephone. He should not forget this fact when he is solicited to use the opposition service. You should keep it before him in every way that only four short years ago he could not only not have a telephone in his home, but that he could not find a toll station in his post office or trading town unless it happened to be one of the 49 larger towns in the State. Then the poles connecting the large cities where messages were plentiful and the rates high encumbered his roads, blockaded his drains, mangled his trees, he could get no nearer to the sound of a telephone than the hum of the wires. Now, your poles encumber his roads, block his ditches and mutilate his trees, but he is compensated by the connection you have given him with his doctor, his market and the world. You have relieved his isolation and made his farmhouse merely a suburban residence. Does he appreciate your service? I think so. Will he patronize his benefactor? Unquestionably. Build him good lines, give him good service and he will not forget.

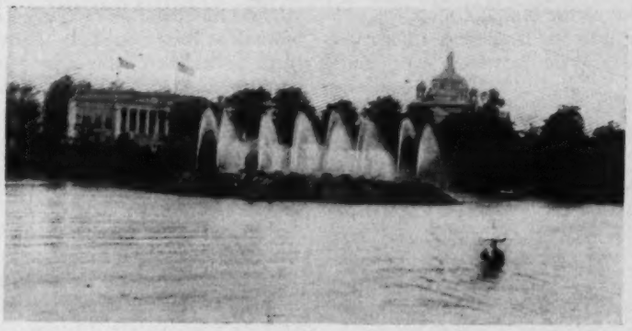
Railway Deals in Ohio.

Last week the Everett-Moore syndicate at Cleveland closed several deals which have been hanging fire for some months. Chief among these was the incorporation and the forming of a preliminary organization of the Lake Shore Electric Railway Company. The temporary capital stock was $10,000, but this will be increased soon to $4,500,000. The incorporators were: Barney Mahler, F. W. Coen, D. G. Jaeger, A. M. Snyder, E. M. Gronamyer and L. M. Hildreth. The permanent officers will be: Barney Mahler, president; F. W. Coen, secretary, and R. E. Danforth, general manager. The new company will operate the lines between Cleveland and Toledo, and includes the Lorain & Cleveland Railway, the Sandusky & Interurban Railway, the Sandusky, Norwalk & Southern Railway, and the Toledo, Fremont & Norwalk Railway. This consolidation was figured on some time ago, but was delayed until the final transfer to the syndicate of the Toledo, Fremont & Norwalk Railway. This road was turned over on Thursday, Aug. 8. The system is in operation except for a short section, and this gap will be completed within the next 60 days. It has been reported that the Toledo & Detroit Shore Line will be operated as a part of the Lake Shore Railway, but this point has not been decided upon. The final transfer to the syndicate of the Toledo city lines also took place last week. The three roads extending east from Cleveland heretofore operated separately as the Cleveland & Eastern Railway, the Cleveland & Chagrin Falls Railway, and the Chagrin Falls & Eastern Railway, have been consolidated under one management, and the system will probably be known as the Cleveland & Eastern Railway. R. L. Andrews, of the Cleveland & Eastern has been appointed general manager of the combined road. The other officers will remain as before the consolidation was effected. The offices and freight station of the three lines have been consolidated at the old quarters of the Chagrin Falls road and the freight business will be conducted separately from that of the Electric Package Company, which controls the freight business of the other Cleveland roads.

Another important move of the Everett-Moore syndicate last week was the organization of the Securities Company, of Cleveland, which will have charge of the financing of the bonds of the various Everett-Moore enterprises. The company is capitalized at $1,000,000, and the incorporators were E. W. Moore, H. A. Everett, Frank S. Borton, Charles W. Wason and H. B. McGraw. Frank S. Borton, secretary of the Cleveland Electric Railway and of the syndicate, has been chosen as the president of the security company.

It is understood that the syndicate has a number of important plans in view for the future. It is stated also that plans are under consideration for a controlling company to handle a freight business of all the various lines, although for the present this branch of the business will be conducted as now. Report has it that the syndicate will build its own car shops and rail mill for the production of its own steel. Mr. Everett states that while the former is a possibility, the latter is out of the question.

Buffalo Convention of American Institute of Electrical Engineers



NEW YORK STATE BUILDING.

ABOUT 125 members and guests of the American Institute of Electrical Engineers boarded the specially chartered steamer "Montauk" at New York on Sunday, Aug. 18, and at 10 a. m. the steamer started on her trip up the Hudson to Albany. The committee in charge of arrangements had carefully provided for the comfort of the passengers, and notwithstanding an overcast sky and threatening rain, the trip will long be remembered by those who participated as one of unqualified enjoyment. An excellent luncheon was provided by Mazetti, and later in the afternoon refreshments were served. A band discoursed music on the forward deck.

The boat arrived at Albany at 6.30 p. m., and about 10 minutes after disembarking special trolley cars took up the party and landed it at the Ten Eyck, where dinner was had and the night passed. On Monday morning, at 8.30, a special train was boarded and a half-hour later it was switched into the works of the General Electric Company at Schenectady. There the passengers were met by Professor Elihu Thomson, Mr. E. W. Rice, Jr., and almost all the members of the works' technical staff. Carriages were waiting to conduct the ladies of the party on an excursion in and about Schenectady. With members of the G. E. staff as guides, the technical visitors were shown through all the important departments of the works in a short time, the party breaking up into groups of from 4 to 10, each with its conductor.

About 2½ hours were spent in inspecting the works, and at noon the entire party, including the ladies, was reunited in an extension now being built to one of the large buildings, which for the occasion had been transformed into a luncheon room, with Mazetti presiding over the culinary department. The tables were handsomely decorated with flowers, and an admirable collation was served.

When the coffee was reached, Mr. E. W. Rice, Jr., in some well-chosen remarks, referred in complimentary terms to the visit to the works of the Institute members and their foreign guests. Professor Elihu Thomson also expressed his pleasure at the visit, and Mr. C. O. Mailloux responded for the visiting party.

When the special train left the works at 1.30 it had on board 134 passengers. Some members did not extend their trip beyond Schenectady, but the party was, on the whole, somewhat increased by a contingent of Institute members joining at Schenectady. Of this total number, 83 were members of the Institute, 18 were foreign guests and 33 ladies. The guests were as follows: Professor Janet and MM. Debeauve, Roux, Marcel Aubert, Maurice Aubert, De la Tour, Courtier, David, all of the Societe Internationale des Electriciens. Messrs. Cooper, Denham, Cottam, Gamleu, Sawers, Pott and McNott, all of the British Institution of Electrical Engineers. J. F. Ch. Janisch, of the Deutscher Elektro-Technische Verein, Professor Gustav Gillon, of Louvain University, Belgium.

Up to the arrival at Buffalo there had not been a hitch in the admirable arrangements that had been made for the professional and social entertainment of the guests. In New York, Albany and Schenectady, members of the local committees were in constant attendance, and the programme fixed in advance was smoothly carried out in all of its details. Much of the credit for this unqualified success is due to Mr. E. H. Mullin, who had direct charge of arrangements for transportation and accommodation. Upon the arrival at Buffalo a new condition was encountered, and until the end of the meeting there was much cause of complaint, due to the lack of arrangements for the reception and entertainment of the party. When the party alighted from the train at Buffalo, no member of the local committee was present at the station, and nothing could be learned as to the arrangements for the transportation of the visitors to the hotel. After lingering about the station for a half hour or more and descending and ascending stairways, much to the discomfort of the ladies, it was learned that a Belt Line train passed near the hotel, and finally the tired party arrived there about 9.30 p. m. To dispose finally of this unpleasant feature of the trip, we may say that the Mayor of Buffalo was not present at the opening of the convention, according to programme, and no explanation of this omission, which was unfortunate in view of the foreign attendance, was offered. On the last day of the session, the custodian of the building in which the meetings were held demanded that the audience room be vacated, and threatened forcible measures if the demand were not complied with. It then appeared that the room had only been secured for three days, instead of the five days called for by the programme, and had it not been for the courtesy of the organization which was to have occupied it on Saturday, the last day's session would have been suddenly cut short. At Paris, members of associations meeting in the Exposition grounds, were charged no admission, but at Buffalo the regular gate charge was exacted in the morning, and upon return to the grounds after a programme visit, admission was again charged.

SESSION OF TUESDAY, AUG. 20.

The convention was called to order about 11 p. m. by President Steinmetz in the lecture hall of the New York State building within the Exposition grounds. Mr. Steinmetz referred to the large number of papers to be presented, almost all of which treated of questions of great timely interest to the electrical engineering profession. To the foreign guests he expressed the high appreciation of the Institute for the cordiality with which its members had been welcomed abroad last year by sister bodies, and hoped that their presence at the present convention would still further strengthen the professional feeling which, like science, should know no country. Professor Janet responded in graceful terms, after which Professor George F. Sever, on behalf of the electrical engineers connected with the Exposition, welcomed the members and offered them every facility within the power of himself and colleagues with respect to the inspection of the various features of the Pan-American electrical plants. After some announcements by the secretary, including an offer of free telephonic service to members from the Buffalo Bell Company, the session was adjourned to 10 a. m. Wednesday morning.

In the afternoon, special trolley cars conveyed all who desired to go to Niagara for a visit to the Falls and objects of scenic interest in the vicinity, this visit being preparatory to a professional one later in the week.

SESSION OF WEDNESDAY, AUG. 21.

Four papers were read at this session—those of Messrs. Lincoln, Haskins, Davis and Browne—the discussion of which, however, was soon diverted to a discussion of the relative merits of direct current and polyphase motors. This latter discussion and the discussions on other days of synchronous versus induction motors, and polyphase versus direct-current traction, formed the three leading features of the convention.

The paper by Professor Browne gives an excellent resumé of the principles involved in power factor indicators and includes a description in detail of numerous types of these instruments. This paper will be printed in abstract in a following issue.

The paper by Mr. Caryl D. Haskins entitled "Some Fundamentals of Electric Meters," dealt specifically with the watt-hour meter in respect to the relation between torque, friction, ageing of various kinds, and local surroundings. In endeavoring to produce a direct-current meter always correct at all readings, friction is the main

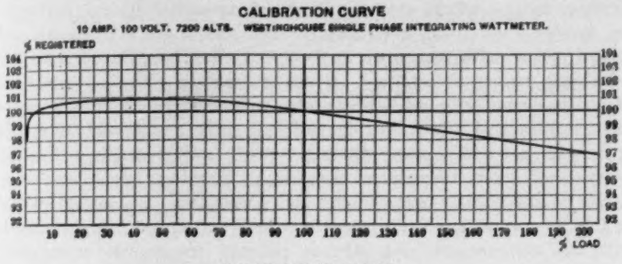
difficulty presented, and particularly changes which occur in friction with time. The remedy favored in the paper is not the minimizing of friction, but compensation for the same, and the radical increase of damping load in relation to possible friction load. With respect to the latter, it is obvious that the description of a relatively very large amount of energy in the Foucault energy disk renders wide variations of friction substantially negligible.

In considering the requirements for this condition, it is stated that the whole essence of success in a motormeter necessarily lies in literally permanent magnets. The question of copper vs. aluminum Foucault disks is discussed, and decided in favor of the latter.

As to compensation for friction, it is not sufficient that friction should be compensated for at an average point of calibration, but also important that the compensation can be instantly adjusted to meet the actual conditions surrounding the meter at its point of use. Instead of restoring the meter to its initial condition periodically by cleaning and the like, it becomes possible, where an adjustable compensation is available, to recompensate at the appropriate time for the permanent friction load and thus restore the meter to a stable condition of equilibrium.

The conclusion of the paper is that the two essentials meriting the most careful study in meter design are, first, the expenditure of the maximum permissible amount of work in the Foucault disk; and, second, the provision of the best means for instantly compensating for friction variation at the point of use without affecting total calibration.

Under the head of "Metering of Electrical Energy," Mr. Harry P. Davis outlined some of the more important features which should be embodied in the ideal motor meter, the several principal points being



CALIBRATION CURVE.

considered under the heads of simplicity, proper design of the rotating element and proper design of the enclosing case.

With reference to the second point, the requirements are that the shaft be short and stiff, and the entire revolving element simple and light in weight, this last consideration being most essential, affecting as it does in a vital manner the portability, life and ability of the meter to remain in calibration. Artificial, complicated and delicate devices for obviating injury to jewels or to act as substitutes for them, should be unnecessary if careful attention is given to these considerations in the design and proportions of the revolving element. The best bearing is a step bearing employing a hard sapphire jewel with a polished cupped surface of large radius supporting a highly polished steel end in the revolving shaft, the revolving element not weighing more than a few grammes and having a low speed. In the case of alternating-current meters the design should be such as not to allow vibrating effects. Stress is laid upon the desirability of an enclosing case of substantial cast material designed to be dust, insect and moisture proof.

To meet the conditions of central station lighting service, a meter should have a wide range, and record accurately to at least within 2 per cent, whether one lamp or the entire number installed are in circuit. A meter of small capacity capable of standing a considerable overload for short periods is most desirable for this case, as it gives very accurate returns for the light loads which are usual.

To illustrate the points of a modern meter the data of a specific one are given. This is a Westinghouse induction meter, in which the magnetic field produced by the windings induce secondary currents in an aluminum disk, causing it to rotate in the same manner as the armature of an induction motor. The design of this meter has been worked out, to give the best all-around result in actual use. The coils are wound on iron cores, with very nearly closed magnetic circuits, thus greatly reducing the magnetizing forces necessary. This is particularly noticeable in the series coil, which in an 80-ampere meter consists of but one turn of wire having a length of about three inches. Meters of other capacities have a proportionate number of turns. As so small a magnetizing force is required, it is evident that the induction drop will be small, and as there are so few turns of wire, it can be made with a very low resistance, conditions which are very necessary to enable the meter to stand a heavy overload. The aluminum disk with its shaft is very light, weighing but 15 grammes.

The accompanying figure is a calibration curve of this meter. This shows that from 1/50 of full load, to 1½ times full load this meter is correct within 1½ per cent, and at twice full load it is still within 3 per cent. The small loss in the series coil of this meter can best be appreciated when it is stated that during this test it carried without injury to itself for a considerable period a load of six times the rated full-load capacity of the meter, representing a heating effect in the series circuit of 36 times that occurring at its normal rating.

In conclusion, the subject of metering polyphase circuits is considered. The use of the two-wattmeter method is criticized, and the employment of a single polyphase meter advocated. Such a meter can be connected either to a two or three-phase circuit, the connections being straightforward, and what is most important, its reading will be on a single dial, and will show the total energy, irrespective of unbalancing of the loads or changes in power factor. The whole question of using single-phase meters on polyphase circuits depends entirely on the balancing of the loads on the several phases, and the power factor of the circuit. In view of the uncertainty of polyphase circuits in this respect, the exclusive use of polyphase meters is to be recommended, ensuring, as they do, accurate registration without regard to these irregularities.

The paper by Mr. Paul M. Lincoln dealt with a synchronism and a frequency indicator, the principles of which are the subject of two patents which were considered in our issue of Aug. 10. A synchronism meter of this type was on exhibition in Electricity Building, where its operation was explained by an attendant. In form it had the appearance of a small motor, on the shaft of which and in front of a white desk was a pointer. In synchronizing the pointer revolved either to the right or to the left, according as the frequency of the e. m. f. of the machine to be synchronized was greater or less than that of the circuit with which it was to be connected. As synchronism was approached, the speed of the pointer was reduced, and when it came to rest exact synchronism was indicated. In detail, both the synchronism and the frequency indicator consisted of two coils at right angles and movable in a magnetic field. Calling the coils at right angles A and B, and the field coil F, in the case of the synchronizer, coil F is connected to a set of bus-bars and coils A and B to a generator to be seen in parallel to the bus-bars. Then the motion of the movable coils gives a constant index of the phase conditions of the generator with respect to the bus-bars. Following is the explanation given of the action of the instrument:

Suppose a stationary coil F has suspended within it a coil A, free to move about an axis in the planes of both coils and including a diameter of each. If an alternating current be passed through both coils, A will take up a position with its plane parallel to F. If now the currents in A and F be reversed with respect to each other, coil A will take up a position of 180 degs. from its former position. Reversal of the relative directions of currents in A and F is equivalent to changing their phase relations by 180 degs., and therefore this change of 180 degs. in phase relations is followed by a corresponding change of 180 degs. in their mechanical relations. Suppose now that instead of reversing the relative direction of currents in A and F, the change in phase relations between them be made gradually and without disturbing the current strength in either coil. It is evident that when the phase difference between A and F reaches 90 degs. the force between A and F will become reduced to zero and a movable system, of which A may be made a part, is in condition to take up any position demanded by any other force.

Let a second member of this movable system consist of coil B, which may be fastened rigidly to coil A, with its plane 90 degs. from that of coil A, and the axis of A passing through a diameter of B. Further suppose a current to circulate through B, whose difference in phase relative to that in A, is always 90 degs. It is evident under these conditions that when the difference in phase between A and F is 90 degs., the movable system will take up a position such that B is parallel to F, because the force between A and F is zero, and the force between B and F is a maximum; similarly, when the difference in phase between B and F is 90 degs., A will be parallel to F. That is, beginning with a phase difference between A and F of 0, a phase change of 90 degs. will be followed by a mechanical change in the

movable system of 90 degs., and each successive change of 90 degs. in phase will be followed by a corresponding mechanical change of 90 degs.

To investigate the mechanical relations corresponding to intermediate phase relations, suppose the phase difference between *A* and *F* to be 0. The force between *A* and *F* will then be a maximum, and that between *B* and *F*, 0. Now, suppose a small change in phase between *A* and *F* to take place. The force between *A* and *F* becomes slightly less than the maximum, and that between *B* and *F* becomes other than 0. The movable system will take up the position of equilibrium between forces on *A* and *B*, which will be somewhere intermediate between *A* parallel to *F*, and *B* parallel to *F*. It is further evident that the direction of motion of the movable system depends upon the sign of the differential change, so that such a device is not only responsive to a change of phase between *A* and *F*, but is also responsive to the direction of that change.

It may be interesting to note that quadrature between *A* and *B* is not absolutely necessary either in the mechanical angle between *A* and *B*, or in the phase angle between their currents. So long as there is a displacement between *A* and *B*, both mechanical and electrical, the device is responsive to phase changes between *A* and *F*.

In the construction of the device, a laminated iron magnetic circuit is used and the phase difference between *A* and *B* is secured by using a non-inductive resistance in series with one coil, and an inductance in series with the other. It is, of course, impossible to secure 90 degs. phase difference in this manner, but sufficient difference can be obtained to answer all practical purposes. Current is introduced into the armature through three slip rings, one of the rings being made to do duty for one end of both armature windings.

The same system may be used as a frequency indicator by placing in series with the field coil a capacity of such a value that at normal frequency the capacity reactance will neutralize the inductive reactance. At normal frequency the current in the coil will therefore be in phase with the impressed e. m. f., but will lead or lag at any change of frequency. The phase relations between the impressed e. m. f. and the currents in the armature will, however, remain practically unchanged with varying frequency, and consequently the angulary movement of the coils *A* and *B* will therefore be a measure of the frequency.

The paper gives an analytical discussion of the principles of both methods, and shows under what conditions a maximum of range and sensitiveness is possible.

In the following discussion Mr. Barstow expressed the opinion that the idle current used in starting induction motors should be metered and an income derived from the same, in which Mr. Haskins concurred. Mr. Steinmetz said that central stations should exercise supervision over the installation of induction motors and see that those giving a large idle current were not installed. He said that means could be devised for indicating and charging separately for the idle current of motors, but doubted the advisability of such a charge. Induction motors can, however, be made to start with very small wattless current. Mr. Mershon said that owing to the short duration of the starting current, the income derived from charging for it at any reasonable price would be very small. Mr. Mailloux suggested that a penalty be charged for wattless current, such a method being in line with the present one of penalty charges for current where the consumer's demand is not a favorable one from the central station standpoint. In reply to a question, Mr. Haskins said that in the usual type of two-rate meter one or the other of two dials is thrown into mesh at certain hours by a clock; the double-dial meter, he added, has been replaced by the single-dial alternate meshing arrangement. Referring to the suggestion that central stations should exert supervision over the installation of induction motors on their circuits, Professor Browne said that the application of a power factor indicator would betray the efficiency of a motor. Mr. Harold W. Buck spoke in complimentary terms of the Lincoln synchronizer, which is employed upon the Niagara plant. Formerly when belted generators were used almost any synchronizing arrangement could be employed, such as incandescent lamps and voltmeters. Where, however, direct-connected machines of great power are used, they must be thrown into circuit as near exact synchronism as possible in order to avoid serious trouble.

Reference to the idle current of induction motors led to a lively discussion of the relative merits of direct-current and induction motors, which occupied almost all the time after the reading of the papers until adjournment. The discussions were participated in by Messrs. Mershon, Dunn, Scott, Steinmetz, Holmes, Mailloux, Fisher, Scott, Hering, Janisch, De la Tour and others. The attitude of those taking the leading part in the discussion was frankly partisan for their respective positions. For the induction motor the principal claims were for greater simplicity, minimum cost of maintenance and greater durability, while for the direct-current motor the claims were urged of less cost, greater flexibility of speed control, less disturbance on regulation, and a higher efficiency at full load and at overload. Those taking the extreme positions conceded on the one hand the better adaptability of the direct-current motor for elevator and street railway service, and on the other hand the better adaptability of the induction motor for use in connection with high-voltage transmission service.

One of the principal charges brought against the alternating-current motor was in connection with the large starting current required. Mr. Dunn stated that in the tests of two motors under the same conditions, a direct-current motor gave 6.4 times the normal torque with 7 times the normal current, while the induction motor took 4.4 times normal current at only 2.2 normal torque, which, moreover, was the maximum torque the latter would stand. In another case it was stated that 8 and 9 times normal torque was required in starting an induction motor. In reply to the latter criticism Mr. Scott said that the motor load probably had abnormal torque, and that a four-fold starting was way above the average, 1½ to 2½ being the usual figures for squirrel-cage rotors. Mr. Mershon said that with starting resistance in the rotor circuit an induction motor can be built to require no more starting torque than a direct-current motor, and that regulation with rotor resistance was just about as good as in the case of direct-current motors when starting, and better than the latter when running. In design there is no limit to the starting torque which may be given an induction motor. While the squirrel-cage rotor undoubtedly does take a large starting current, a motor with resistance in the rotor circuit would not require more than 10 per cent excess current in starting. Mr. Scott said it should be borne in mind that the abnormal current at starting only had a duration of a few seconds, and that while a motor of the rotor resistance type had a lower starting current, such a motor was more complicated than the squirrel-cage type. He dwelt upon the simplicity of the squirrel-cage motor and pointed out that as an offset to the magnetizing or idle current which it required, it dispensed with the commutator and brushes and the consequent attendance upon the same.

Mr. Dunn said that while he admitted the simplicity of the induction motor and its superiority in connection with high voltages, he considered it open to a number of objections in connection with general power distribution. The starting current was only one objection to the induction motor. In shop work it was not equal to the direct-current in speed, in regulation, in torque or in efficiency, the latter in the case of the direct-current motor being higher at both normal load and overload. In the case of factory work speed control is the dominant factor. Moreover, a direct-current motor costs less and its installation does not reduce the capacity of the generating plant and it requires less copper for distribution. He considered that too much stress had been laid upon the commutator and brushes, which required but slight attention; in fact, faults really did not commonly occur at the commutator, but at the rocker arm. Both induction and direct-currents have to be inspected at intervals, and it is little additional trouble to attend to the brushes of direct-current motors at such inspection. An instance was cited where direct-current motors were employed in a graphite plant where graphite settled an inch or more thick on the motors without interfering with their operation. It was suggested that in this case the small air-gap of an induction motor would have been filled up and its operation rendered impracticable. Mr. Dunn said that comparisons between direct-current and induction motors were invariably made on the old records of the former while the introduction of the induction motor was so recent that records relating to it were yet lacking. In view of the great progress constantly being made in connection with direct-current motors, it was unfair to judge the motor of to-day on the records of the past. In the discussion the fact was brought out that direct-current elevator motors are now frequently so designed as to take less current at starting than at normal load.

Mr. Mershon said that the greater cost of induction motors was counterbalanced by their advantages. Referring to the performance of motors in graphite dust, Mr. Mershon said that such dust was good for induction motors, and he spoke of a case where induction motors were running satisfactorily in a quartz mill and covered with quartz dust. Mr. Scott said that the objection to the induction mo-

tor on the score of the greater generating capacity due to idle current required, could be met with the statement that the extra copper and other material in the direct-current motor could be transferred to the generator, thereby decreasing its capacity sufficiently to take care of idle current. Mr. Holmes created a laugh by resuming some of the statements made as to the great simplicity of construction and few parts of the induction motor as compared with the direct-current motor, and then asking why this model of simplicity should cost so much more than its alleged greatly complicated direct-current rival.

Mr. Mailloux referred to a case where induction motors had been installed and then had to be removed owing to the difficulties in starting, a 50-hp motor blowing the fuse on a 150-hp generator. Referring to this and other criticisms of a similar kind, Mr. Scott said that they are invalid in the absence of data as to the starting torque of the motor load, which in some instances, as in the case of flour mills, is abnormal and would similarly affect direct-current motors.

Messrs. Steinmetz, Janisch, De la Tour and others held that both types of motors have their field. The former created a laugh by saying that an induction motor is undoubtedly best for use in a powder mill, while the superior claims of the direct-current motor for elevator service could not be contested. Between these two limits there was much debatable ground, and it lay with the engineer to decide in each specific case which type of motor was the better for that case.

On Wednesday evening special trolley cars were provided for a trip to Niagara, where the party witnessed an illumination of the gorge rapids by powerful arc lights.

SESSION OF THURSDAY, AUG. 22.

Five papers were read at this session, those of Professor Aldrich and Messrs. Perrine, Scott, Steinmetz and Rice. As in the case of the previous meeting and the following meetings of the convention, discussion was deferred until after the reading of all the papers.

The first paper read was that of Professor W. S. Aldrich and George W. Redfield, entitled "Performance of an Artificial Forty-Mile Transmission Line." It gives a description of a transmission line set up in the electrical engineering laboratory of the University of Illinois, and a number of tests made on the line and apparatus connected therewith. An abstract of this paper will be given in a following issue.

A paper was then read by Professor F. A. C. Perrine, on the "Elements of Design Particularly Pertaining to Long-Distance Transmission." The question of capacity was particularly dwelt upon, which was shown to be the predominant factor in long high-voltage transmission lines. It is pointed out that in the case of a line of 100 miles in length operating at a voltage of 50,000 or 60,000, and with a periodicity of 50, the line-charging current is 2000 kilovolts, the introduction of units smaller than 2000 kilowatts is thus inadvisable, and the transmission of power less than 3000 kilowatts commercially impractical in such a case unless the capacity effect be neutralized by the use of reactive coils. The influence of the wave form in long-distance transmission was discussed with reference to the capacity of the line. Curves taken by means of an oscillograph show that the effect of capacity in circuit is to reduce the accentuation of the teeth of the current curve. It is stated that by far the most important effect of capacity in circuit is that which relates to the regulation of transformers and generators attached to the line, since leading current taken from such apparatus has the effect of decreasing the voltage, while lagging current increases it proportionately. An abstract of this paper will be printed in a following issue.

The next paper was by Mr. Charles F. Scott, on "The Induction Motor and the Rotary Converter, and Their Relation to the Transmission System." The greater part of the paper is taken up with a consideration of the relative merits of the induction and synchronous motors, between which a comparison is made in parallel columns under 10 main heads and 37 sub-heads, the former being as follows: Auxiliary apparatus; starting, normal; starting, abnormal; starting and maximum running torque; speed; current; power factor; reaction upon generator and circuit; and causes which may accidentally stop a motor. With a few exceptions, the comparisons are very strongly in favor of the induction motor. The summary is as follows:

The induction motor is a passive element in the system, each motor attending to its own work and not trying to run the system. The synchronous motor is an active element in the system. It acts as a generator, impressing its own wave form, its e. m. f., and its fluctuations upon the circuit, which fluctuations may be caused by an intermittent load. The induction motor is not sensitive to differences in the design of other apparatus operating on the same system. The synchronous motor is a sensitive element in the system. Its successful operation is dependent upon the proper design of the motor itself, and the other machines connected with the system, and also upon the proper adjustment and freedom from speed fluctuation in generators and other motors. It is liable to momentary variations from normal conditions, such as a sudden overload and sudden decrease of generator speed, or momentary fall in e. m. f. With the induction motor no experience and electrical skill are required of the attendant, and there is little or nothing to get out of order, either through carelessness or design. The synchronous motor requires skill and care on the part of the attendant for starting and for adjusting, and for keeping the brushes and auxiliary apparatus in proper condition. The induction motor has a definite power factor, depending upon the load. The out-of-phase current does not vary greatly at different loads, and a changing load, therefore, has comparatively little effect upon the drop in voltage, and in regular service there is little liability that the motor will disturb the e. m. f. of the circuit. The power factor in the case of the synchronous motor is under the control of the operator, and the current may be made leading or lagging. Instruments are necessary, however, in order that proper adjustment may be made by the attendants. The induction motor and its operation are simple and reliable, while the synchronous motor and its operation are complex and involve many possibilities of accident. In conclusion, it is stated that the synchronous motor is now rarely considered seriously as a competitor of the induction motor, except in large sizes.

The second part of the paper deals with the rotary converter in comparison with the motor-generator. The rotary converter is stated to have the advantage over the motor-generator in point of cost, there being but one machine instead of two. In point of efficiency, there being a loss in only one machine instead of two, and in its effect upon the voltage of the transmission system, as it may be compounded to overcome the drop which would otherwise occur in generators and transmission circuits. On the other hand, the direct-current e. m. f. of a motor-driven generator is not dependent on the e. m. f. of the supply circuit, and may be adjusted or compounded, as desired. It is added, however, that the voltage delivered by a rotary converter may be satisfactorily adjusted and controlled by regulating devices or by compounding, so that usually the close relation between the e. m. f.'s at the two ends of the converter is not disadvantageous, provided the e. m. f. of the supply circuit is reasonably constant. It is admitted that there are special cases, as where the voltage has to be adjusted over a very wide range, where the motor-generator is to be preferred. The opinion is expressed that a motor-generator employing a synchronous motor does not seem to possess any exceptional advantages over the converter, except in some cases where the independent control of the direct-current voltage is desired. A motor-generator employing an induction motor secures many of the advantages set forth in the preceding comparison between synchronous and induction motors, such as in being particularly applicable to circuits supplied with generators in which the speed has a rapid and periodical fluctuation, or with which, for any reason, the use of a synchronous machine is impractical or undesirable. The induction motor driving a generator is also to be preferred where units are quite small and the attendance is unskillful.

A short concluding section of the paper deals with the alternator. It is stated that an alternator which may be quite satisfactory for lighting purposes may be wholly inadequate for successfully supplying current for either induction motors or rotary converters. For the latter service an alternator should have good inherent regulation, as suddenly changing loads or the throwing on or off of motors cause fluctuations in voltage to which external devices for adjusting for field current cannot act quickly enough to prevent disturbance. For the operation of rotary converters the generator speed should be uniform, and the generators should also have good inherent regulation, not only in order that the e. m. f. may be maintained at heavy loads, but for the purpose of holding the converter rigidly in synchronism. The field should be stiff and the iron not saturated, in order to prevent shifting of the magnetic field back and forth with changing armature currents. In conclusion, a generator which is to supply induction motors or rotary converters should be selected with reference to the service which it is to supply. In some cases unsatisfactory results have been obtained in the use of motors or

converters, and the trouble has been located in fluctuating speed or in the characteristics of the alternators supplying the circuit.

Undoubtedly the most important paper read before the convention was that by President Steinmetz, entitled "Theoretical Investigations of Some Oscillations of Extremely High Potential in Alternating High-Potential Transmissions." The paper forms, in fact, one of the most important in the long series of valuable papers which Mr. Steinmetz has contributed to the Transactions of the Institute. With capacity circuits any change in circuit conditions involves an electric oscillation, and Mr. Steinmetz gives for the first time a systematic treatment relating to the rise of potential on lines containing capacity due to conditions which cause electric oscillations. Leaving aside harmonics, such conditions may arise from pulling a switch, extinguishing a short circuit, or starting up a generator, all of which will produce oscillations or frequencies which may be very rapid.

In his paper Mr. Steinmetz said that the first time he noticed such a phenomenon was when making a series of observations on the effect of opening a high-potential circuit with different types of circuit breakers, on an artificial line consisting of inductive coils and about half a mile of high-potential cable, with a spark-gap between needle points connected across the system, to measure an instantaneous rise of voltage. If the needle points were brought so close together that a discharge occurred between them, an extremely high voltage was invariably induced locally in the system, of a total striking distance reaching as high as 40 inches, or between one-quarter and one-half million volts, the normal voltage of the system being about 10,000. The explanation of this phenomenon is probably as follows:

By striking between the needle points shunting the circuit, the system was short circuited and thus instantly drained of its electrostatic charge, so that the potential locally fell to practically nothing, while an excessive current passed between the needle points as arc. By the heating effect of this current the arc was instantly blown out explosively and thus the short-circuit current of the system ruptured. After the explosion the discharge between the needle points again short circuited, interrupted itself, etc. The phenomenon is thus of similar character, but infinitely greater power to the action of the Wehnelt interrupter (the latter depending upon the combined effect of self-induction and electrolytic polarization), while the phenomenon observed occurred with self-induction and capacity.

Since that time in a number of instances of high-potential circuits electrical discharges were noticed, with striking distances many times greater than that of the normal potential of the system, under circumstances where a short-circuiting arc interrupted itself in the open air. A short circuit in a constrained space, as in a buried cable, does not appear to give this effect.

From this and other reasons, Mr. Steinmetz was led to believe that a short-circuiting high-potential arc in free space, in a system containing self-induction and capacity, is a self-interrupting phenomenon, and thus may cause very serious high-potential effects. On any high-potential limited power transformer this phenomenon can be observed in the entire change of the character of the arc between the high-potential terminals when inserting capacity in shunt. From the flame of the steady and noiseless arc, which curves upward by its heat, the discharge changes to the glaring white, noisy, lightning-like, destructive high-potential oscillation. This change can be shown photographically, the photographs giving in the absence of capacity, the striations of the successive half waves of the impressed frequency, while in the latter case they show a system of successive electrostatic sparks not followed by the striated alternating arc flame. As shown by Mr. W. S. Andrews, a number of oscillating discharges may occur during the same half wave of alternating primary e. m. f.

The paper then proceeds with an exhaustive mathematical investigation of the electric character of electric oscillations which may be produced in high-transmission lines, and in conclusion several numerical examples are worked out.

In one the case is considered of a transmission line carrying 100 amperes at full load, under an impressed e. m. f. of 20,000 volts, the resistance drop being 8 per cent, the inductance voltage 15 per cent of the impressed voltage, and the charging current 8 per cent of full-load current. The resistance drop in the step-up transformers is assumed at 1 per cent, and the reactance voltage 2½ per cent.

The resistance drop between constant potential generator terminals and middle of transmission line is then 5 per cent, or $r = 10$ ohms. The inductance voltage is 10 per cent, or $x = 20$ ohms. The charging current of the line is 8 amperes, and consequently the capacity reactance is $K = 2500$ ohms. Assuming a sine wave, the impressed e. m. f. is 28,280 volts. In this case the rise in voltage due to rupturing the line under short circuit would be tenfold, or 282,800 volts.

In the case referred to in the beginning of the paper, the distinctive voltage was induced by a short circuit on an experimental 10,000-volt, 40-cycle line. During the occurrence of the phenomenon the generator voltage probably fell to about 5000, due to limited capacity. The resistance of the system was very low, about $r = 1$ ohm, while the inductive reactance may be estimated as $x = 10$ ohms, and the capacity reactance as $k = 20{,}000$ ohms. From these data the equations deduced show that the oscillation had a frequency of 1800 cycles, and a maximum e. m. f. of nearly one-third million volts.

The paper ends with the following conclusions:

1. The most important sources of destructive high-voltage phenomena in high-potential circuits containing inductance and capacity are not resonance phenomena from the wave of impressed e. m. f. or its higher harmonics in case of the deviation of the wave from sine shape, but are electric oscillations produced by a change of circuit conditions, as starting, opening circuit, etc.

2. These phenomena are essentially independent of frequency and wave shape and of impressed e. m. f., but depend upon the conditions under which the circuit is changed, as in the manner of change and the point of the impressed e. m. f. and current wave at which the change occurs.

3. The electric oscillations occurring in connecting a transmission line to the generator are not of dangerous potential, but the oscillations produced by opening the transmission circuit under load may give rise to destructive voltages, and the oscillations caused by interrupting a short-circuit are liable to reach voltages far beyond the strength of any insulation. Thus special precautions should be taken in opening a high-potential circuit under load. But the most dangerous phenomenon is a low resistance short circuit in open space.

4. The voltages produced by the oscillations in open circuiting a transmission line under load or under short circuit are moderate if the opening of the circuit occurs at a certain point of the e. m. f. wave. This point approximately coincides with the moment of zero current.

The last paper read at the Thursday session was one by Mr. E. W. Rice, Jr., on "The Control of High-Potential Systems of Large Power." This paper, which will be printed in full abstract in a following issue, deals with the development and present status of switches for the control of circuits of high-voltage supplied with a great amount of power. A considerable portion of the paper is devoted to a description of the type of large cellular oil switches employed on the New York Metropolitan Railway. In conclusion, the paper outlines the principles which should govern the layout of large generating stations of from 5000 kilowatts and over.

The discussion of the foregoing papers was participated in by Professor Janet, Professors Shepardson and Aldrich, Messrs. Fisher, Kennelly, Steinmetz, Mershon, Perrine, Stillwell, Scott and others. Professor Shephardson said that assuming the discharge from high-voltage conductors to be a function of the diameter, aluminum conductors are indicated as preferable to copper on account of the increased diameter for a given resistance. He suggested that the stranding of such conductors might, however, counterbalance this advantage, but Dr. Perrine said that as the effect is dependent upon the surface of the conductors, a stranded conductor would act the same as a solid one. He also said that the employment of aluminum was limited to stranded conductors. Mr. Fisher referred to some sparking experiments in which it was shown that the introduction of capacity increased the sparking, and he suggested that the capacity caused the e. m. f. wave to become more peaked. Mr. Emmet took issue with a statement in Mr. Scott's paper that the wave form of the generator should be observed in the selection of apparatus for use on circuits supplied by it. He said that it was not at all necessary to design motors, converters and generators for each other. As to synchronous motors, the worst results in their use arises from overloading, and the trouble from running synchronous apparatus in parallel is negligible. Referring to high-voltage insulation, Mr. Emmet said that dry air is a good insulator, but it is easily punctured. On the other hand, solid insulators require considerable energy to puncture them, and overtones usually did not continue long enough to supply such energy. At Niagara Falls abnormal e. m. f.'s will cause long jumps through air, but no trouble has been found in transformer insulation, and the same is true with respect to the effects of lightning discharges. Mr. Kennelly said

that he considered that Mr. Scott's paper showed too much harshness toward synchronous motors, and that in many cases a mixed system would be best, being made more flexible by the employment of synchronous motors. Mr. Kennelly made a plea to drop the word "rotary" and simply use "converter" in referring to rotary converters. He referred in high terms to Mr. Steinmetz's paper, which show the importance of the evanescent constant in the algebraic equation. This is evident from the fact that it might give rise to a voltage 100 times the fundamental, as shown by Mr. Steinmetz, and without the presence of harmonics, since the cases considered by Mr. Steinmetz were independent of the wave form. He spoke of the interesting analogy of Mr. Steinmetz between the effect set up by the Wehnelt interrupter and that by the breaking of a short-circuit, or the analogy between electrolytic capacity and static capacity.

Mr. Steinmetz, referring to Mr. Scott's paper, said that the synchronous motor is entirely suitable where a large motor is needed, and the induction motor is similarly suitable where the reverse is the case. He said that he had designed 100,000-kw induction motors, and the same capacity of synchronous motors, and he had seen no reason to change his belief that synchronous motors are preferable to induction motors where the former can be used. It is true, however, that the starting torque of a large induction motor is larger than that of the synchronous motor. The latter has a larger air-gap and a power factor of from 95 to 100 per cent. Both motors drop out of step at excessive load, while the synchronous motor can be adjusted to have no deleterious reaction on the generator, and be made to have a beneficial action on the circuit. For many services the induction motor requires resistance in its rotor circuit. He challenged the statement that the squirrel-cage induction motor can be started on 1½ normal current, and said that the wave shape could not properly be used to explain trouble from the operation of alternating-current motors. At Niagara, for example, in passing from two-phase to three-phase the peak of one of the phases is made different from the peak of the other two phases, and yet no trouble had ever been experienced in the operation of apparatus from this fact.

Referring to a statement that intervening resistance beyond a small amount is prohibitive to the running in parallel of synchronous apparatus, he stated that a 60-cycle synchronous converter has been operated heavily loaded in parallel at the end of the 22-mile line for eight months, and no trouble experienced. Another advantage of synchronous motors in a station is that they can be used as generators in case of necessity, and such motors had a higher efficiency—95 per cent and over—than alternating-current generators. A synchronous motor can be operated at 10,000 volts or more, while an induction motor requires transformers with high voltages, and it is more expensive than the synchronous type.

Dr. Perrine said the advantages that Mr. Scott had enumerated for the induction motor were possible ones, but were not always realized in practice. He referred to one case where a 700-kw generator would not start a 300-kw motor, and to another case where four friction clutches were necessary on shafting driven by an induction motor. Mr. Scott said in reply that he believed the large torque in these cases was due to the fact that the motors were driving a flour mill where an enormous torque is required in starting up. Dr. Perrine said that the operation of synchronous motors requires some skill, but that in California almost all the plants use such motors, many of them in mines where the conditions are particularly trying, and yet with good results. At a recent meeting of the Pacific Coast Electrical Transmission Association, the consensus of opinion was that for large powers it is not advisable to use induction motors, except where there are ignorant employes. He referred to the desirability of synchronous motors as part of a steam reserve, and said that several years ago every synchronous motor in California was running as a generator.

Mr. Stillwell said that he preferred induction motors wherever their use was possible, and that the only point in favor of the synchronous motor is its high power factor, and this was apparent rather than real, owing to the lack of skilled attendance. In terminal stations the attendance is sufficiently skillful for synchronous motors, but sub-station expenses would be increased should they be installed there. At Niagara better results had been achieved from the use of induction than synchronous motors. When the potential of the synchronous motor drops it lets go. It is true that the clearance of the induction motors is less than that of the synchronous motor, but the latter may introduce harmonics. As to wave shape, no trouble from defective wave shape has been experienced in the Niagara plant.

Mr. Oberlin Smith considered that induction motors are preferable to synchronous motors for running machine shops. Mr. Mershon referred to his Telluride high-voltage experiments, and said that the discharge from line is dependent upon the diameter of the conductor and the distance apart of the conductors. The loss from stranded cables is greater at first, but decreases as the surface of the latter become somewhat corroded. He found that there was less loss from the line at the receiving than at the generating station, and that the loss was largely dependent upon the wave form, being greater with a peaked wave. The form of the wave was found to vary with the capacity in circuit. As to the relative merits of the induction and synchronous motor, he favored the former, but each had its sphere. As to the power factor, that of the synchronous motor could not be maintained if adjustments were not made with changes of load. As to efficiency, he said that recently in the case of some bids, manufacturers had guaranteed about the same efficiency in each case.

Professor Janet spoke of the great value of Mr. Steinmetz's paper, which showed clearly what bad effects might come over short circuiting the line containing capacity. He mentioned a case that came under his observation during the Paris Exposition when a workman drove a nail in a cable, which was simultaneously punctured a mile or more distant. He spoke of the desirability of reverse circuit breakers, and was informed by Mr. Steinmetz that these were largely used in this country. Professor Aldrich called attention to the experiment detailed in his paper, showing that by proper adjustment the synchronous motor would neutralize the power factor of a line. Professor Perrine said that the general effect of capacity is to depress the peak of the wave, but sometimes the reverse occurs and harmonics are accentuated. Mr. Scott, referring to the statements of Mr. Steinmetz and Mr. Emmet that synchronous motors are superior to the induction motor when the conditions are proper, said that more conditions favored the induction motor. A synchronous motor must have a starting motor and therefore starting current as in the case of the induction motor. When started without load the two are on a parity. Mr. Scott said that it was true that lowering the voltage lowers the efficiency of the induction motor more than that of the synchronous motor. In case of an overload the synchronous motor stops immediately, while the stop of the induction motor is gradual. As to the instance cited by Professor Perrine concerning experience in starting a flour mill, Mr. Steinmetz asked what the effect would have been had the synchronous motors been used, and added that the manufacturing company referred to in making a recent addition to its plant had purchased, not a synchronous, but an induction motor.

After the adjournment of the session a visit was made to the Buffalo terminal station of the Niagara line.

Thursday was "Electrical Day," and in honor of the occasion there was a special display of fireworks in the evening, which included a set piece limning the features of Mr. Henry Rustin, chief of the Electrical and Mechanical Bureau. It was ludicrously unfortunate that on this night above all others there should be an interruption of electrical service, and yet this is what occurred. A short circuit developed on one of the cables in the Exposition grounds, and for two hours the Exposition was in darkness.

SESSION OF FRIDAY, AUG. 23.

Two papers were read at this session, one by Mr. L. B. Stillwell entitled "A Description of the Niagara Falls Transmission Plant," and another by Mr. A. J. Wurts entitled "The Development of the Nernst Lamp in America." The latter paper is printed in full elsewhere in this issue. A full abstract of Mr. Stillwell's paper will appear in a following number, and some comment relating to the same will be found in our editorial pages. The paper is by far the most voluminous presented at the meeting, filling 91 pages of the Transactions, which corresponds to about 20 pages of this journal.

A considerable portion of the paper is historical, and Mr. Stillwell quotes frequently from his correspondence with the Niagara Company, in which he proposed a number of features, the adoption of which have greatly conduced to the success of the installation. Mr. Stillwell said that the wisdom of the decision to reject the three-phase system is now at least open to question, but added that if a new Niagara problem were presented to-day with conditions such as are met with the existing plant, he would be still inclined to use two-phase alternators. He considers that the wisdom of the selection of the frequency of 25 cycles per second has been demonstrated, though he personally considers 30 cycles preferable. The town of

Echota is satisfactorily lighted by incandescent lights using 25-cycle current, but this condition he believed to be somewhat helped by the fact that the potential wave of the Niagara alternators is flatter than a sine wave.

The paper gives an account in detail of the first three alternators as planned and constructed, and their operation under test in service. It is stated that the general mechanical features of these alternators—that is, the external revolving field with inwardly projecting field poles surrounding a centrally located and stationary armature—were proposed by Professor Forbes. The two following sections of the paper deal with the design, test and operation of alternators Nos. 4 to 10. The change in the construction of these latter alternators is stated to be not material as affecting their money-earning power. Their advantages may be summed up in the statement that the efficiency is about .3 per cent higher, the regulation is somewhat closer and the limiting temperature under continuous full load about 15 degs. C. lower.

The remaining sections of the paper deal with the exciters, the switching apparatus and measuring instruments, transmission and distribution, and equipment of power house No. 2. Load curves are given in the paper for local and long-distance service as compiled from half-hourly wattmeter readings for the 24 hours ending at midnight, July 21, 1891. The local load varies between 13,200 kilowatts and 15,700 kilowatts. This marked uniformity of output is explained by the fact that nearly all of the power used locally is delivered to manufacturing companies whose processes are continuous, and whose use of power is practically constant. The long-distance load varies from a minimum of 3300 to a maximum of 15,600 kilowatts. Of this maximum probably 90 per cent is used for railway and lighting purposes. The average total load is about 24,000 kilowatts. The loss in the lines averages about 6.5 per cent. By calculation, with this line loss the net efficiency of the step-up transformers, line and step-down transformers, should be 89.5 per cent. As measured, the efficiency has been found to be 88.4 per cent. The more important features in which the equipment of the new power house will differ from that of the old power house are as follows:

In the new power house the alternator equipment will comprise eleven 3730-kilowatt, two-phase alternators, wound for 2200 volts. All switch gear and measuring instruments will be located in one structure instead of in two, as in the old power house. All switches will be of the General Electric cellular oil type, and they will be manipulated from a dummy switchboard. The regulation of the alternators will be materially closer than the older machines, and the external appearance will be considerably changed. The exciters will not be located above ground, as in the case of the old power house, but in chambers excavated in the sides of the wheel pit at the level of the turbine floor. The new alternators will be used for long-distance service and the old ones for local service.

Comparing the Niagara plant with a steam plant of the same type, it is stated that on the basis of 3 lbs. of coal per unit at the switchboard, more than 800 tons of coal per day would be burned.

Part was taken in the discussion by Messrs. Steinmetz, Buck, Lincoln, Sperry, Perrine, Stott and others. In reply to a question by Mr. Steinmetz, Mr. Stillwell said that the e. m. f. curves had been taken off for different loads, and that the load e. m. f. wave was distorted. Mr. Buck said that the history of the Niagara plant resumes the greater part of the history of electrical engineering since 1891. It jumped the size of the generators from a few hundred kilowatts to 5000 horse-power, raised the generated voltage from 1100 to 2200, and the system of 1891 remains the standard of to-day.

Mr. Lincoln referred to the deterioration of the rubber of cables, which he considered to be due to a static effect. An instance was cited of rubber cable with 9/32 insulation, and held in porcelain insulators clamped on the wall. The cable had originally withstood 100,000 volts, but after a week it broke down on 13,000 volts strain between the line and ground. He said that the deterioration may be due to ozone generated by static discharge to ground, which statement was supported by Mr. Sperry, who said that a rubber hose with a 5/8-inch wall is rendered useless in a day and a half in an atmosphere containing 1½ per cent of ozone.

Professor Perrine spoke of the unreliability of resistance temperature measurements, and said that a proper specification would provide for the highest thermometer temperature and the average resistance temprature.

In reply to a question as to how the trouble from anchor ice was obviated, Mr. Stillwell said that the racks were lifted and the ice allowed to go through the wheel.

Referring to interruptions of Niagara service, he said that 30 per cent were to be charged to the cables, 30 per cent to exposed contacts such as at circuit breakers, 10 per cent to carelessness in throwing switches by unskillful men, 10 per cent from outside interferences with the line and 20 per cent to lightning. Interruptions due to the first two mentioned causes could be reduced, but he doubted if there could be any improvement with respect to the three last mentioned causes, which are responsible for 40 per cent of trouble. In answer to a question as to trouble from lightning in California, Dr. Perrine said that in the case of the Blue Lake line the trouble was principally due to lightning induction along 200 miles of line. He doubted the utility of choke coils, but favored their use for the reason that they introduced more lightning arresters into the circuit. Long lines in California are protected by barbed wire grounded at every fourth pole on an iron spike at the bottom of the pole. One of the functions of barbed wire is to keep the line discharged. It was found that a dead line is charged by a dry wind blowing across it. He considered barbed wire better than smooth wire, and expressed the opinion that it furnished the best lightning protection. Lightning effects he classed under three heads, as follows: Neighborhood discharges, giving rise to inductive effects; secondary discharges and direct discharges. The first two may be guarded against by lightning protecting devices, but as to the third he said that we must "trust in Providence."

The discussion of the Nernst paper by Mr. Wurts was joined in by Messrs. Howell, Steinmetz, Hammer and others. In answer to a question, Mr. Wurts said that in the six-glower lamp the heater was cut out of circuit after two glowers had become conducting, the heat of the latter bringing the other glowers up to the conducting temperature. In reply to a question by Mr. Howell, Mr. Wurts said that experiments had been made with lamps in vacuum, but that such an arrangement is impracticable commercially. No relation was discovered between the conducting and the fusing temperature. Mr. Howell said that the lamp appeared to be limited by the necessity for ballast, and since different materials conduct at widely different temperatures, this limited the employment of ballast to certain materials and limits of temperature. In reply to a question, Mr. Wurts said that in the six-glower lamp the platinum of each glower is worth 2 cents, and platinum in the heater 8 cents. The price of a six-glower lamp would probably be about $8, and that of a single-glower lamp $3. Mr. Howell dwelt upon the fact that the Nernst lamp requires a considerable excess of current in starting, which in the case of a single-glower lamp is about double that of the normal current. Mr. Wurts pointed out that this disparity was very much smaller in the case of a six-glower lamp, and, moreover, that the starting current decreased fom maximum to normal within four seconds. He stated that the life of the glower is about 800 hours, and there is only a few per cent of deterioration during the life.

Mr. Steinmetz said that it is not fair to compare the Nernst lamp in its present state with the incandescent lamp, which has been in commercial use for 20 years. He considered that the candle-power of the Nernst lamp is not comparable with that of incandescent lamps owing to the quality of the light given out.

In reply to a question, Mr. Wurts said that the temperature of the glower is about 2500 degs. C., as determined by calorimetric test. He said that while there was some blackening it is not as serious as in the case of the incandescent lamp, and could, moreover, be easily removed. Mr. Hammer spoke of the superiority of the American type of Nernst lamp over the European type, particularly in discarding the method of connecting the glower and the use of a spiral heater. In reply to a question, Mr. Wurts said that the life of the direct-current glower is about 300 hours, and that while it might be made 500 hours, this type of lamp is not so good as the alternating-current type. He said that the Nernst lamp was particularly indicated for use in dry goods stores, factories, railroad stations and yards, etc. It would probably not be a sharp competitor of the incandescent lamps, except where the latter are used grouped. One of its advantages is that it can be used on 25-cycle circuits, tests having shown no difference in the quality of the light from 25 and 60-cycle circuits. Mr. Howell said that the curves of the paper showed that in a six-glower lamp the normal current is 2.3 amperes, and the starting current 3.5 amperes. This statement was confirmed by Mr. Wurts. In conclusion, Mr. Wurts announced that the commercial manufacture of the Nernst lamp would be commenced in a large factory in Pittsburg within two weeks.

In the afternoon a trip was made by special trolley to Niagara, where the power houses of the Niagara Falls Power Company and

the Niagara Falls Hydraulic Power & Manufacturing Company were visited. Some members of the party also visited the works of the Carborundum Company. Among the events of the evening was a dinner given by Professor Janet, at which a number of prominent members of the Institute were guests.

SESSION OF SATURDAY, AUG. 24.

Two papers were read at this session of the convention, one by Mr. A. H. Armstrong, entitled "Notes on Modern Electric Railway Practice," and the other by E. J. Berg, on "Electric Railway Apparatus." Both of these papers will be printed in full abstract in a following issue. The main feature of both papers was a discussion of the relative merits of direct and alternating-current motors for electric traction service, and in both cases the conclusions were that in almost every respect the direct-current motor is superior to the alternating-current motor for electric railway service. A possible exception, however, was made in both papers in the case of long lines over level ground with infrequent stops.

Upon the conclusion of the reading of the papers, Mr. Gifford described a method of starting converters as simple shunt motors, thus obviating the difficulties otherwise resulting from variations in the voltage of the starting current. Professor Gillon gave some details of the polyphase traction experiments at Berlin at high speeds and employing a potential of 10,000 volts. He expressed the opinion that under certain conditions with respect to starting, this system was applicable where the direct-current system would fail. With respect to the use of polyphase motors for urban traction, he said that the arguments made against this system were based upon high acceleration, but as high speeds are never used in urban service, any arguments against the polyphase motor based upon such speeds were unfair. Polyphase motors, he said, can be designed to give as large a starting torque as may be desired by momentarily increasing the voltage at the terminals. Professor Gillon expressed the opinion that the air resistance offered to a train consisted largely of frictional resistance against the lateral sides of the train. Mr. Janisch also referred to the Berlin-Zossen experiments, which were carried out by the company of which works he is chief engineer. He said the tests were satisfactory as to the application of the polyphase system to high-speed traction. It was found, however, that the overhead trolley is not practicable for high speeds, and at Zossen side contacts were substituted. He intimated that the reason the work had not been followed up was due to the disfavor with which the German Government viewed prospective electric roads with respect to competition with State lines and cost of transforming the latter from steam to electricity.

Mr. Arnold expressed regret that American engineers were antagonistic to the three-phase railway, and that we had to go abroad to find the defenders of this system. Personally, he was a friend of the direct-current rotary-converter system, and therefore in a position to consider impartially the merits of the polyphase system. He believed that, if left to themselves, our American engineers will solve the problem. One solution of this problem he considered to be the use of energy usually dissipated in starting a train. Electric elevator motors are started at less than normal current, and he believes that the same can be done with polyphase motors. He considered that Mr. Berg's example, which worked out against the polyphase system was not fair, since it applied to a shorter road well adapted for direct-current traction. With a longer road his conclusions would be modified. He believed that the direct-current motor is best, in connection with sub-stations, for urban roads and also best for interurban roads with light cars. For heavy railroading he was strongly in favor of the alternating-current system.

Mr. Mailloux said that short runs precluded the use of the alternating-current motor. The greater the speed the greater the difficulty for the alternating-current motor, due to acceleration. The problem is a function of the speed and the length of run. Integral acceleration curves he considered give the best indication as to the relative merits of direct and alternating-current motors for railway traction, and he referred to Mr. Berg's diagrams as showing that the direct-current motor is better than the alternating-current motor for accelerating. The starting torque of an alternating-current motor is only 2½ to 3 times that of the running torque, while that of the direct-current motor is 4 or 5 times greater. In conclusion, he said that the question of alternating-current motors in electric traction was one for the future and not for the present.

Professor E. P. Roberts expressed disappointment at the statements made concerning alternating-current traction, particularly in view of present conditions in Ohio which seem to call for the use of the alternating-current system. Owing to recent consolidations of railroads in Ohio the connected lines are very long, and he had hoped that this would produce conditions that will permit the substitution of alternating-current traction.

Mr. Stillwell said that in the electric railway field we had been apt to go along old lines and have not given sufficient attention to alternating currents. He believed that the question should not be considered generally, but with respect to specific cases. An objection to the present sub-station system is that it is dependent upon three or four points of supply, each point demanding the exercise of skill. On the other hand, with the alternating-current system, all the skill could be concentrated at one point. With a direct-current system and a number of sub-stations the reserve and corresponding investment is out of all proportion with the generating plant. For example, in the Manhattan system there is one reserve generator and seven reserve rotaries. On a large direct-current sub-station system the acceleration is limited by fluctuations in the sub-stations, for though the fluctuations may be moderate at the power house they may be extreme in the sub-stations. Before adopting the alternating-current system, however, it must be worked out for specific cases. As to the claims of greater transmission efficiency of the alternating-current system, he said that on New York elevated roads this saving would only apply to 18 per cent on the total cost, so that by raising the efficiency from 80 or 90 per cent by the use of alternating currents, the increase would be but 2 per cent, not considering the labor element or a large saving in investment. In conclusion he said that to-day the sub-station system is the best for large cities.

Mr. Arnold coincided with Mr. Stillwell in this latter conclusion, saying that the sub-station system was the best to-day for urban and slow-speed interurban roads. For heavy railroading, however, the alternating current is alone applicable, and he quoted a railroad president who has operated both steam and electric roads for five years to the effect that he can carry freight cheaper with electricity than with steam. As to the factor of acceleration in the railway problem, he had thoroughly considered it, and what he said in favor of the alternating-current system was said with a full knowledge of the importance of this factor. In conclusion, he said that he did not like to see American engineers take the attitude that the direct-current system is perfection and appear to be antagonistic to the alternating-current system.

Professor Roberts said that he found that sub-station charges were a great factor in transportation charges. Mr. Steinmetz said that at one time he believed that the polyphase system had a higher transmission efficiency and less operating expense, but after thoroughly considering the question recently he has found that the transmission efficiency is less, owing to the inefficiency of the induction motor. With the induction motor the fluctuations are very great and transformer sub-stations would be required, and this latter is the electrical apparatus which will stand less overloading, with the consequence that the expense for transformer plant would be very great. Rotary converters require extremely little attention and not much expense.

Mr. Potts, of London, said that in the face of such very diverse opinions as to the relative merits of the direct and alternating-current railway systems, he thought it best to say nothing in view of the smaller experience of Great Britain in electric traction. He referred to the very much lower bid offered in London in connection with the Ganz system and said that he would regret it if American manufacturers did not obtain the work.

Mr. Scott said that the papers which had been read confirmed calculations that had been made by Westinghouse engineers. He gave some figures which confirmed those arrived at by Mr. Berg, and said that the conclusions of the Westinghouse engineers coincided with those of the General Electric engineers to the effect that the saving with the polyphase system would be negative. As to the saving from braking with the latter system, since braking cannot be done under half speed, the saving would be slight, and the increased weight of apparatus would more than take this up. He said it was better to coast and to give up braking. He said that the opinion of the company engineers was also confirmed by Mr. Stillwell in connection with the New York elevated system. The advantage of alternating-current motors on grades was, in fact, a disadvantage. The same

size of direct-current motor would give higher speed on the level or low grades and thus make up for the lesser speed on high grades.

Mr. Scott referred to a remark made by one of the foreign guests, who said he did not understand the position of the American company's engineers in their antagonism to polyphase railways, but ascribed it as a commercial policy of their employers. Mr. Scott repelled this insinuation, and said that the commercial departments of the companies were, on the other hand, constantly urging the engineers toward the alternating-current system. He said the question was really not one of alternating current vs. direct current, but that of series vs. shunt motors. If direct-current shunt motors are not good for railway service the induction motor is not good. The invention of a speed-changing device might change the situation. In conclusion, he said that he coincided with the authors of the papers in that the induction motor is not applicable for electric railway service.

Mr. Potts asked to be allowed to make a personal explanation concerning a remark he had made as to the influence of manufacturing companies with respect to the position taken by their engineers on the polyphase railway question, which he did not wish to be applied in any personal sense. One could, however, generally take it for granted that manufacturers are in favor of the apparatus they can supply with the most profit to themselves. Mr. Steinmetz said that this latter point was true, but it was a serious matter for companies to be left behind and that, in fact, they are always seeking to make advances. He said that his company had done a great deal of work on the problem under discussion, but there were no results thus far, except in the supply of six induction motor cars, and these for a railway of Italy.

Mr. Stillwell said that direct-current systems, although used on the New York and Chicago railways, were not in themselves ideal. With reference to the greater efficiency of the direct current over the induction motor, he pointed out that in the case of the former there may be 35 per cent difference between the energy delivered to a car and that used. He expressed the strong hope that our manufacturing companies would not accept the direct-current system as perfect and bury the alternating-current system, and said that if the latter system were adopted and found successful in London, it would be a blow to American electrical engineering prestige.

Mr. Steinmetz said that the advantage of the return of energy to the line by braking was not borne out. The solution of the traction problem was to accelerate as fast as possible, then coast, and then in stopping let the energy be dissipated by rolling friction. Mr. Stearns expressed the opinion that the alternating-current system is best for long runs on interurban roads. Mr. Spalding described a speed-changing device, which he thought might be applicable to electric railway motors. This consisted of a pair of disks, each with a beveled face, one disk being adjustable. A beveled belt runs between the two disks, which may be adjusted to give different transmission diameters. Mr. Holmes said he had seen a car driven by this device, and expressed the opinion that the alternating current would prove an economical substitute for steam between New York to Albany.

Mr. Mailloux said that an important favor in the problem of high-speed railways was that of air resistance. At high speeds the rolling friction is negligible in comparison with the air friction, and he hoped that some data would soon be forthcoming relating to the latter. The problem is rendered indeterminate at high speed, and the supply of data calls for the joint effort of all interested. Mr. Armstrong said that the General Electric engineers had been disappointed at the inapplicability of the induction motor in railway work. As to its application to suburban roads, he said these were governed by the same conditions as city roads, the higher speed schedule counteracting the effect of stops at longer intervals.

At the conclusion of the discussion, Secretary Pope read a telegram from Mr. William Stanley, Jr., inviting the Institute to hold its next annual convention in the Berkshire Hills.

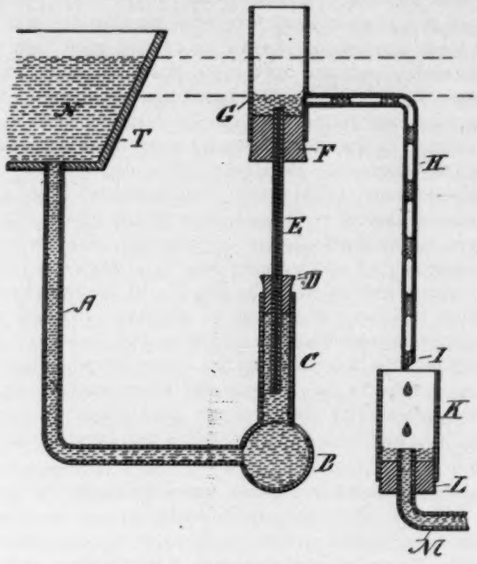
During the session resolutions were unanimously adopted for presentation to Dr. Schuyler Skatts Wheeler and Mr. Andrew Carnegie, expressing the high appreciation of the Institute for the gift, from the former, of the Latimer Clark Library, and, from the latter, of $6,880.20 for cataloging, housing and completing of the same.

British Pacific Cable.

The bill for the construction of a Pacific cable by the Imperial Government and the Australasian colonies has passed the House of Lords on its final reading.

Supply Device for Electrolytic Cells.

An ingenious contrivance, designed for feeding the electrolyte to decomposition cells, and in particular to those operating upon salt solutions for the production of caustic alkali and chlorine, forms the subject of a patent recently granted to Raoul Girouard, of Westbrook, Me. In electrolytic plants of this character it is essential that the concentration of the chloride solution shall be equal in all cells, and this renders it desirable to supply all cells from a common reservoir, which, however, is impracticable with any continuous system of piping, for even though the conduits be of insulating material, the continuous column of electrolyte will serve as a path for the leakage of appreciable amounts of current from cell to cell. Accordingly, it has been the practice to interpose in each supply pipe a circuit-breaking device, usually with moving parts, and generally operating as a ladle, to dip up at regular intervals a quantity of electrolyte from the common supply tank and deliver it to the feed pipes of the electrolyzer. Carmichael, for instance, has employed for this purpose a tube, bent roughly into the shape of the letter S, and so mounted upon a revolving shaft as to dip up a small quantity of electrolyte and by further rotation to deliver it to the supply funnels of the cells. Recently he has described and patented a modified form of the apparatus in which the parts are so arranged and formed that the quantity of electrolyte delivered shall be independent of the level in the supply tank, a result simply effected by constructing the ladle in the form of an oscillatory pipe, etc.



SUPPLY DEVICE FOR ELECTROLYTIC CELLS.

Girouard dispenses with moving parts and breaks the continuity of the discharge from the reservoir by the simple expedient of a restricted conduit provided with a free discharge end, the parts being so arranged as to break the outflowing column into a succession of drops. The accompanying figure is almost self-explanatory, *T*, *N*, representing the main supply reservoir, and *B* the electrolyte main from which all cells are supplied, the reservoir and main being in communication through the conduit *A*. The main *B* is fitted with a series of risers *C*, one opposite each electrolytic cell and each closed by a plug *D*, through which passes snugly the vertical tube *E*. This tube carries upon its upper end a small delivery vessel *G*, closed below as at *F*, but open above to the air. From the side of this vessel an outlet, *H*, *I*, leads to the funnel *K*, *L*, *M*, which is the inlet proper for the electrolyzer.

The operation of the apparatus is dependent upon the relative capacities of the tubes *E* and *H*. The tube *E* must restrict the flow of the electrolyte by virtue of the surface friction which it opposes to the liquid, and the necessary restriction may be obtained either by increasing the length of the tube or by decreasing its bore. The pipe *H*, on the other hand, must be capable of freely conducting away all electrolyte reaching the delivery vessel *G*, and must have such excess of carrying capacity as will permit it to depress intermittently the level of the liquid in the delivery vessel and allow the entrance of a quantity of air sufficient to break the continuity of the column of liquid. Regulation of the feed is readily effected by sliding the tube *E* in the plug *D*, thus varying the head.

CURRENT NEWS AND NOTES.

AUTOMOBILE EXPOSITION IN BUDAPEST.—United States Consul Chester at Budapest, Austria-Hungary, reports the recent opening of the first automobile exposition in that country. About 70 machines are on exhibition. The Locomobile Company of America is the only American concern represented. French, Austrian and German machines are shown.

AUTOMOBILE ROAD RACES.—Owing to the failure of the Pan-American authorities to secure the necessary consent for the proposed 100-mile road race from Buffalo to Erie in September, the Automobile Club of America regrets to announce that its annual sweepstakes race and one-mile record race will not be run over this course. Although the consent has been absolutely promised for some time, it has not been received, and failing such consent no definitive action could be taken by the club. The time is now entirely too short in which to receive entries and successfully organize a race of such an international character as this race was intended to be. The governors of the club have therefore decided to endeavor to hold these events elsewhere in the month of October, preserving its international character by inviting entries from abroad as originally proposed. There will therefore be no week of automobile sports at Buffalo.

ALTERNATING-CURRENT MOTOR METER.—Mr. A. Peloux, of Geneva, Switzerland, is the assignor to the Rittener Electric Meter Company, of that city, of a patent issued here for an alternating-current motor meter based on the principle that a cylinder or disk of metal may be inductively influenced by two alternating currents differing in phase from one another by a fraction of a period, whereby the said cylinder or disk is caused to rotate. In carrying out his invention he provides a disk of metal secured to a shaft and fixed to rotate in suitable bearings; also a main series coil having an independent core and two pressure or shunt coils, one on either side of the series coil, having independent cores and an armature to complete the magnetic circuit through said cores. He places a self-induction coil in the circuit of and in series with the shunt coils and a permanent magnet between whose poles the disk revolves and means for regulating the magnetic reluctance of the magnet.

TELEPHONIC GESTURES.—In the course of the English telephone investigation, it was stated that at Glasgow when people got angry because the line was busy, they threw the instruments around, injuring them. With regard to similar practices in Cuba, the Philadelphia *North American* says: In Cuba and the South to-day the receivers of most telephones are attached to the wall in such a way that they are moved up and down in a slot to the height of the ear of the person who wishes to speak. An American sent to Havana to take charge of a telephone service is the inventor of the method. Soon after his arrival he found that charges for repairing receivers was a large item of expense, and he investigated. He found that his customers soon after they had begun speaking would begin to gesticulate with both hands. The hand that held the receiver generally accented its gesture by jamming the thing into the wall. It was soon out of order. Now that both receiver and transmitter are worked without hands the expenses are much less, besides which the customer has free use of his hands.

OVERHEAD TROLLEY CONTACTS.—Reminiscent of a chapter in trolley history and litigation but recently closed, is a patent just issued to Mr. George Westinghouse, for a means of "getting around" the use of the under contact wheel trolley, which still prevails despite some obvious shortcomings. Mr. Westinghouse's invention involves the employment of an extended contact device, such, for instance, as a cylindrical tube or roller supported in a suitable manner above the car in contact with the under side of the overhead conductor. The cylindrical tube or roller is of such a length that some portion of it will usually remain in contact with the conductor. For the purpose of employing as short a tube or roller as practicable, and yet insure that the contact device shall not escape from the conductor, non-revoluble lateral extensions may be provided at the respective ends of the roller. The extensions are replaceable; but inasmuch as the contact device is for the most part with the roller and the conductor is in contact with the extensions only at intervals the wear upon them would not be excessive.

DYNAMO DESIGN.—Mr. B. G. Lamme, in a recent patent, takes up the subject of armature winding for alternating-current generators. Without a diagram it is not more susceptible of simple description than armature windings usually are, but the underlying idea is thus characterized: "The object is to provide a generator which shall have certain advantages over those heretofore designed and employed in similar relations. Among such advantages are the utilization of an armature which has a large number of slots and a small number of conductors per circuit; one which may have as many circuits in parallel as may be desired without regard to the number of field-magnet poles; one in which each circuit is uniformly distributed entirely around the armature periphery; one in which the coils are so constructed and arranged that in case of accident to any winding the remaining windings will be uniformly distributed and may therefore be used satisfactorily; one in which the windings may be used independently for separate circuits, if desired; one in which part of the windings may be reversed when the number of circuits is an odd number, so as to provide a symmetrical arrangement, and one in which the difference of potential between adjacent end conductors is less than that between the end conductors of any one of the windings that are nearest to each other."

ELECTRIC DRILLS.—Up to the present time little real progress has been made with electric drills, but the subject is in its early stages, and the resources of the art are by no means exhausted. This is shown in the invention recently patented by Mr. Ralph D. Mershon. It has been proposed prior to this to so construct a cylindrical electromagnetic motor or engine that longitudinally-shifting magnetic fields produced therein by means of polyphase currents may be alternately reversed in direction by means of switching devices operated by the generator, which supplies the current to the motor, and thus effect a reciprocatory movement of the secondary member or armature. Such an arrangement is unsatisfactory, because the reversals of the magnetic fields are dependent upon the speed of the generator, which in practice is substantially constant, and are therefore effected without regard to the natural vibratory period of the secondary member or armature, in which case the secondary member will not start up from a state of rest unless its natural vibratory period is the same or approximately the same as that of the reversals produced by the generator-switching devices, and in practice this is a condition extremely difficult to secure. Mr. Mershon describes in detail and has had claims allowed to him for such a drill in which this is improved upon and the desirable object is accomplished of giving the business end of the tool a partial rotation electro-magnetically between two successive strokes, so that the chisel-shaped cutting edge strikes the material operated upon, at different angles, and thus a practically cylindrical hole is drilled.

ELECTRIC FUSE CUT-OUTS.—In a patent just granted to Mr. Louis W. Downes, of Providence, R. I., a plug type fuse is shown, adapted for use on circuits carrying electric current of high capacity, say, for example, 100 amperes, possessing structural compactness and simplicity enabling it to be produced and sold at a comparatively low initial cost and capable of being readily renewed or refused at slight expense after it has burned out. Without this last mentioned qualification the use of high-capacity fuses of this type would be prohibitive, as a repetition of the initial cost every time the fuse burns out would probably involve greater expense than the user could endure. This Downes fuse comprises an insulating casing capable of resisting the destructive forces and gases generated upon the burning out of the fuse-link and a drum or sheath removably inserted in the casing and inclosing the fuse-link and its surrounding non-conducting heat-dissipating material. The casing carries suitable external circuit contacts adapted to engage corresponding contacts when in place in a socket or the like. The drum or sheath has contacts, between which the fuse-link or links are connected, adapted to engage corresponding contacts on the interior of the casing, whereby the circuit is completed through the fuse-link. The interior of the drum is charged with finely divided non-conducting material, such as slaked lime, and a number of minute holes or interstices allow the escape of the gas evolved upon the blowing of the fuse by an excessive current. To renew the fuse a new drum, which is made of light paper or fibrous material, is inserted for that in which the fuse-links have been melted.

SAFEGUARDING ROYAL TOURISTS.—A dispatch from St. John's, N. F., states that the Marconi system of wireless telegraphy will be installed on Cape Race in order to communicate with the British Royal yacht "Ophir," bearing the Duke and Duchess of Cornwall and York, when she approaches the Newfoundland coast in October. The idea is to prevent the possibility of an accident to the "Ophir" in waters where so many vessels have been wrecked during the present season.

POWER TRANSMISSION FOR CHICAGO.—A Chicago newspaper reports that steps have been taken for the development of electric power on the Kankakee River at Kankakee, Ill., and transmitting it to Chicago, where it will be utilized for street railway and power purposes. It is estimated that 15,000 horse-power can be obtained by damming the river according to a system, of which Mr. E. R. Beardsley, of Waldron, Ill., is said to be the inventor. A company has, it is reported, been organized with a capital of $150,000 to carry out the project.

NEW YORK STATE STREET RAILWAYS.—The Street Railway Association of the State of New York is to meet in Rochester, Sept. 10 and 11. Mr. G. T. Rogers is president. The first day will be given up entirely to the business meeting, followed in the evening by the usual banquet, which will probably be held at Ontario Beach. A portion of the second day will be occupied by a business meeting, followed by an excellent programme of entertainment arranged by Mr. T. J. Nicholl and the local committee. Upwards of 600 invitations have been sent to supply houses, asking them to send representatives and make exhibits. From the responses received thus far, a large number of supply men will be present. The usual number of brief and concise papers upon street railway topics of practical interest will be read and discussed. In addition to the papers mentioned and in accordance with the following resolution: "Resolved, That the topic 'How to Increase the Efficiency of Employes' be separated under different heads, to be suggested by Mr. H. H. Vreeland, and that he allot to the various street railway companies throughout the State the various sub-topics suggested, and that representatives of the respective roads prepare to discuss the same at the next annual meeting," the following assignment to make 10-minute addresses upon this subject under the following subdivisions has been made by Mr. Vreeland (for the purpose of opening discussion): "Discipline," E. G. Connette, general manager Syracuse Rapid Transit Company; "Benefit of Benefit Associations," Orrin Root, assistant general manager Metropolitan Street Railway Company, New York; "The Proper Selection and Training," J. P. E. Clark, general manager Binghamton Railroad Company.

INDUCTION MOTOR DESIGN.—A patent, for which application was filed in May, 1899, has just been issued to Mr. B. G. Lamme for an improvement in induction motors, aimed at economical variation of speed. In motors of this general class, such speed variation is obtained by varying the e. m. f.'s applied to the primary members, and it is necessary or at least desirable for satisfactory operation that the secondary members should have windings of relatively high resistance. In order to avoid complication of structure and liability to disarrangement in operation, it is desirable to dispense with collector rings and short circuiting devices for automatically cutting out the major portion of the secondary resistance for high speeds. If such features are dispensed with and the resistance be therefore permanently included in circuit, the resistance must be capable of taking care of comparatively high losses at low speeds, since the losses in the secondary for any given torque are proportional to the slip or the drop in speed. If low-speed running occurs at more or less frequent intervals during a given period of operation, it is desirable to store the heat due to the secondary losses during such low-speed running and to dissipate it during the times when the motor is running at higher speeds, and consequently when it is subject to a lesser degree of loss in its secondary winding. In order to dissipate the heat at low speeds, it is necessary to make the end rings of comparatively small dimensions, such as would be suitable for normal high-speed operation. If a motor that is provided with such rings be operated for a considerable length of time at a low speed, the heat generated in the rings is likely to be so intense as to destroy or to at least seriously impair them. On the other hand, if the rings be made of sufficient size to store the heat generated in them, they will operate without danger of injury until an increase of speed reduces the heat-generating action and permits of dissipation of the stored heat. Under such conditions the secondary resistance proposed by Mr. Lamme constitutes, in effect, a heat flywheel, which tends to promote a maximum degree of economy in the operation of the motor. The section, material, weight, etc., of the secondary conducting bars and end connectors must be such that the losses therein during low-speed running will not raise the temperature above a predetermined degree which represents satisfactory and safe conditions for a given period of operation. By increasing the amount of material in the secondary circuits, especially in the end rings, sufficiently to keep the temperature within the limits of safe operation, the length of time during which the motor may be run at low speeds may be made as great as desired.

LETTERS TO THE EDITORS.

Heating of Rotary Converter Armatures.

To the Editors of Electrical World and Engineer:

Sirs.—May I trespass upon your space to make a remark in regard to the biographical sketch of Mr. Ralph D. Mershon in your issue of Aug. 17? In that sketch there is allusion made to a paper on rotary converters, written in 1894, and published in the *Electrical World* about the same time, which seems to have been almost entirely overlooked by the engineering world. It may therefore not be amiss to call attention to the fact that this paper of Mr. Mershon's is the first which dealt with the development of heat in the armature of a rotary converter and of a double-current generator. The treatment there given is mathematically concise and short, but covers the theory very completely. In this paper Mr. Mershon arrived to the logical conclusion that an increase in the number of leads permitted an increase in the rated output of the converter as far as the heating of the armature is concerned. His arrival at this conclusion is a very pretty illustration of the power of logical analysis as applied to engineering problems.

In view of the great influence that the rotary converter has exercised of late on the development of heavy electrical engineering, Mr. Mershon's paper, given seven years ago, should deserve more attention than has hitherto been paid to it.

SOUTH NORWOOD, OHIO. B. A. BEHREND.

Power Distribution in Steel Works.

To the Editors of Electrical World and Engineer:

Sirs.—I read with interest the article in your issue of Aug. 17 concerning the power plant in the Brooklyn Navy Yard, and think that we have quite a power plant in the works of the Lorain Steel Company, as we operate over 170 motors, ranging from 5 horse-power to 75 horse-power, under as trying conditions probably as exist anywhere.

These motors, which are all direct-current wound for 220 volts, are of all makers, principally General Electric. They run continuously 24 hours a day, exposed to the fiercest heat, dampness, and are manipulated by unskilled operators, yet their operation will compare favorably with that of any power plant I have handled under far more favorable conditions.

We have a generating plant consisting of four Siemens & Halske direct-connected generators, and one Westinghouse generator, the total capacity of all being 1300 kilowatts. In addition to these we have two Brush, 100-light arc machines, and two 500-light Westinghouse alternators, and all these operate daily in heat, dampness, steel dust and flying graphite, yet the percentage of shut downs will compare favorably with any central station operating under better conditions.

I shall watch with much interest the operation of a similar plant operated with induction motors, and shall hope to read further accounts of it in your valuable paper.

LORAIN, OHIO. C. H. HINES.

Humming in Church.

To the Editors of Electrical World and Engineer:

Sirs.—The following little incident may be of some interest to electrical contractors: A certain church in New Jersey had been equipped with an electric light system, the conductors being in-

stalled in regular iron pipe, or conduit. The installation seemed satisfactory in every respect and the contractor was complimented on his work. When the electric light company connected the system with the alternating-current transformer, a very distinct humming noise was heard in all parts of the building. It was so loud that the clergyman could be heard with difficulty. Experts worked over the matter for two or three days, without avail, and finally decided that it must be the inductive vibrations of the transformer, transmitted along the conductors, and multiplied by the galvanized iron ventilating ducts, on which the conduit had been laid. The conduits were removed from the ducts, which were suspended from the basement ceiling, and the humming had ceased.

What electrical contractor would not have taken advantage of those ducts for the same purpose? A great deal of time could be saved and few contractors would have thought for a moment of the results. There are many well educated engineers, but who among the wise will claim that he "has nothing to learn"?

NEWARK, N. J. G. W. COOK.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Induction Motor with Power Factor Equal to Unity.—A. HEYLAND.—An illustrated description of an induction motor without phase difference between e. m. f. and current. The principal features is that the rotary field is produced not by the primary, but directly from the secondary. To explain the principle of his motor, he starts from the explanation of the action of a three-phase induction motor with an ordinary short circuited armature of the squirrel cage type, as shown in the adjoining diagram. *A* is the

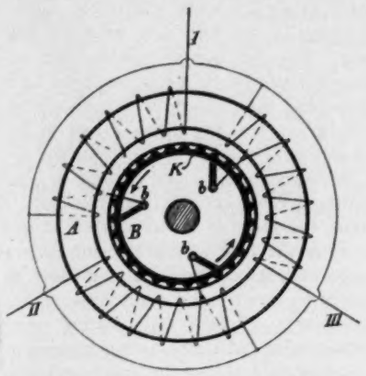


DIAGRAM OF INDUCTION MOTOR.

primary, *B* the secondary, with copper bars laid in slots and connected at both ends by short circuiting metallic rings *K*. A three-phase alternating-current supplied to *A* produces a rotary field which passes through both the primary *A* and the secondary *B* and causes the torque, as well known. The exciting currents in the primary are alternating currents of the full period and do not correspond therefore to the required field excitation, but are much greater. As is well known, in alternating-current circuits of high frequency, there is a large counter e. m. f., and the magnetizing current is produced only by the relatively small difference of the voltage at the terminals and the counter e. m. f. This causes a large phase difference. The energy of these currents, changed into heat in the copper, is very small. All these consequences are avoided by generating the rotary field directly in the short circuited armature and not in the primary. In the short circuited armature *B* there is only a very small small counter e. m. f., the frequency is here very small and depends upon the slip of the motor. While the e. m. f. in the primary is great, that in the secondary is relatively very small. Hence if the magnetizing currents required for the generation of the rotary field are supplied to the secondary, all the consequences of the high counter e. m. f. which exists in the primary are avoided. The only problem is to send the magnetizing currents into the closed winding of the secondary in such a manner that they have exactly the same direction and phase as the magnetizing currents of the stator which they must compensate. This is done in a very simple manner, illustrated in the diagram by means of three brushes *b b b*, which slide upon the ring *K*. Their position relatively to the primary is so adjusted that the currents supplied to the secondary have exactly the same direction which the magnetizing currents of the primary had. The voltage of these currents needs to be only very small, and they may be taken from a few windings of the primary. What takes place here is a conversion of the current from a high frequency (in the primary) to a lower frequency (in the secondary short circuited armature), but for this conversion no commutator in the ordinary sense is required, but a continuous ring is used, as in the diagram. In practice, however, one should not in general use a so-called squirrel cage armature, because the current density at the brushes would be too large, but one may close a wound armature by a ring, the resistance of which is in a certain proportion to that of the winding. This has no great influence upon the efficiency. The most particular feature of the motor is the conversion of the currents by means of a closed ring as commutator. It is evident that such a "commutator" is not complicated at all, but just as simple and sparkless as a slipring. It is true that a part of the magnetizing current is lost in the ring which is shunted to the armature; but the magnetizing current itself is reduced to such a degree that this loss is of no importance. In the practical application it is to be recommended, not to use a uniform ring, but a "commutator," the segments of which are connected together by conductors of low resistance, this makes no difference in the principle, and sparking at the brushes is here also avoided. Finally, it is posible to use at the same time a short circuited armature and a second magnetizing winding with commutator. The self-inductance of the commutator winding is then annulled by the short circuited winding, and sparks at the brushes are avoided. He points out the disadvantage which follow from the phase difference in the induction motor, and the advantages which his motor has for this reason. He also points out that such a motor may be used as generator and has then great advantages, especially when operating in parallel with other generators. Many of the greatest difficulties, which are inherent in the ordinary generator, are here missing. Several experimental motors are being built by two of the largest German electric companies.—*Elek. Zeit.*, Aug. 8.

Design of Large Generators.—A. HEYLAND.—An illustrated paper, read before the Electrotechnical Society, of Vienna, on "General principles of the modern design of large direct current and alternating-current generators." He first draws some general conclusions which are valid for both direct and alternating-current machines, and which follow from the problem to obtain as good an efficiency as possible and to reduce the cost of materials to a minimum, with a given temperature limit for continuous load. These general conclusions are: Breadth of the slots equal to breadth of the teeth; poles of square or circular cross-section; breadth of the armature equal to the ratio of the circumference to the number of poles. In the design of direct-current machines these general rules can be strictly followed, as the choice of the number of poles is not restricted; in alternating-current machines, however, when a certain frequency and speed are wanted, the number of poles is given. In order to avoid sparking at the brushes of direct-current machines he recommends to use broad, open and not too deep slots, and, laminates poleshoes, to avoid too high a temperature in the same. In direct-current machines the armature reactance is not of great importance. In general for the excitation so many ampere windings are chosen, as required for the air-gap. The ratio of the field ampere turns at no load to the armature ampere turns is often unity or still smaller. If one would use such a direct-current machine as an alternating-current machine by replacing the commutator by slip-rings, the machine would give alternating current, but of a lower frequency than is generally used. But it would not be a good alter-

nating-current machine, because the large armature reactance would produce too large a voltage drop with non-inductive load and still more with inductive load. Moreover, such a machine would not operate well when connected in parallel with other machines. For a good alternator the following main points must be obtained: Small armature reaction, hence a relatively large number of excitation ampere windings is to be placed on the magnet pole; the ratio of field ampere windings to armature ampere windings is generally chosen between 3 and 5. To avoid hunting, the poleshoes should not be laminated, but should consist of solid iron or steel. The slots should not be open, but closed. The general differences between the designs of direct-current and alternating-current machines are therefore as follows: For the direct-current machine relatively large armature reactance, open slots, laminated poles or poleshoes; for the alternator small armature reaction, solid damping poles and poleshoes, suitably closed slots. He then speaks about windings and gives a graphical representation of Arnold's series parallel winding. An important point is the saturation of the iron in the magnet poles, especially of the self-exciting direct-current dynamo. High saturation reduces the effect of armature reaction; the best magnetic density is about 17,000. Regarding the choice of the number of poles, he shows that machines with few poles become heavier, but have a better efficiency than machines with more poles. Regarding the speed, he shows that high speed means saving of material as well as high efficiency. These statements are mathematically represented by very simple formulas. In the discussion which followed, Eichberg criticized some smaller points of the paper. Regarding the theory of commutation of direct-current machines he called attention to the importance of the theories of Arnold, Fischer-Hinnen, and especially of Ryan.—*Zeit. f. Elek.*, June 16, 23.

REFERENCES.

Short-Circuit Current of Three-Phase Induction Motors.—SIEWERT.—A long illustrated theoretical article in which he develops a formula for the short-circuit current of three-phase induction motors. It appears from it that a variation of the breadth of the air-gap can have almost no influence upon the value of the short-circuit current, and that the latter increases with increasing magnetization; in general, it is of advantage to make the slots as deep as possible and not too narrow. Four numerical examples are added.—*Elek. Zeit.*, Aug. 1.

LIGHTS AND LIGHTING.

Nernst Lamp.—A. H.—An article giving an account of experiments made with three commercial 220-volt, 200-watt Nernst lamps. They were continually tested until they failed. The life of the three lamps was 124, 293 and 369 hours, respectively. All three lamps were destroyed because the glower feeding wire melted close to the incandescent body. The results of photometric tests of the lamp, the life of which was 369 hours, are given in a diagram and a table. The voltage was continually 220 volts, the candle-power dropped from 146 candles at the start to 99 after 100 hours, 81 after 220 hours, 60 after 300 hours, and 48 after 350 hours, the watts consumed per candle being 1.33, 1.91, 2.19, 2.68 and 2.89, respectively. In practice it seems preferable to use a lamp not more than 200 hours, i. e., down to about 80 candles. He estimates that with a lamp used to this point, the cost of the candle-hour (including cost of operation and amortization), is 0.035 cent, against 0.055 cent with an ordinary incandescent lamp, consuming 3.25 watts per candle. (See also the extended tests of Wedding, noticed in last week's Digest.)—*Elek. Anz.*, July 4.

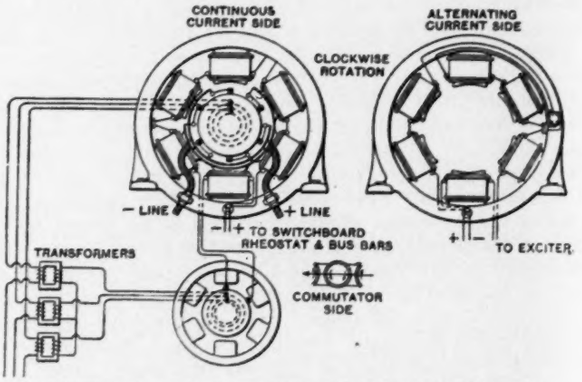
REFERENCES.

Refuse Destructors.—HIGHFIELD.—A reprint in full of his Brit. Mun. Elec. Ass'n paper on "Refuse destructors in combination with electric power stations," and also of the discussion which followed, abstracts of which have already been noticed in the Digest.—Lond. *Elec.*, Aug. 9.

Electric Cranes.—WELLNER.—A description of several cranes recently made by the Co. Internationale d'Electricite.—*Zeit. Ver Deutsch. Ing.*, Mar. 2; abstracted in *Science Abstracts*, July.

TRACTION.

Dublin Tramway System.—The first part of a very well illustrated description of the Dublin tramway system which has been developed under the direction of H. F. Parshall, the well-known former American engineer. Although the main system has been running for over 18 months, several important extension works have been carried out. The two original generating stations have been shut down, and the whole power is now supplied from one plant, and existing sub-stations are changed over from motor-generator to rotary converter sub-stations. The total length of the route is 50 miles and the length of single track 89 miles, served by a total number of 250 cars normally. About 40 miles of the system is supplied with current direct from the generating station. The remainder or suburban part of the system is supplied from three sub-stations. The main or city system is divided up into 19 sections independently supplied and controlled from the generating station, but these can be interconnected at will. In order to reduce the leakage from the rails which are used for the return currents four negative booster points have been provided which are connected to the generating stations by means of insulated cables, connected in series with the armature of the "negative boosters," the fields of which are placed in series with certain of the positive feeders. The power plant contains five direct-current dynamos for supplying the main part of the system, and one three-phase generator for supplying the sub-stations, the voltage of the three-phase currents in the transmission line being 2500. In addition to this, there are two synchronous converters as a reserve to the three-phase generator. Their normal function is to convert from direct-current to three-phase alternating current which is then transformed up by means of transformers to the transmission voltage of 2500, as during hours of light load the load on the three-phase side is not sufficient to warrant the running of a three-phase generator. A peculiar feature of the synchronous converters is that each converter has a small booster attached to the end of the shaft. This booster is really another synchronous converter and consists of an armature with three collector rings and a commutator revolving in the field ring with six poles, but without any field winding. The function of this booster is, in conjunction with three series transformers, to keep the speed of the synchronous converter constant, and thus maintain its periodicity and synchronism. The necessity for this apparatus arises in this way. When converting from alternating to direct current, the speed of the converter is fixed by the frequency and cannot be varied by altering the field excitation. When converting, however, from direct to alternating current, the speed of the converter, as in a direct-current motor, depends upon the field strength, being increased by a weak field and decreased by a strong field. It is evident, therefore, that it is liable to a charge in speed under conditions of increased load and phase displacement, and will deliver alternating current at a varying frequency in consequence. An alternating lagging current weakens the field, thus tending to increase the speed and frequency, so that, under certain conditions with an induction load, a converter may get out of synchronism. To meet this difficulty, the main current on the alternating side is made to pass through three small transformers, one in each phase. The secondary windings of these three transformers are connected together in star fashion, and the three leads carried to the collector rings of the auxiliary synchronous converter or booster, the commutator of which is in series with the field winding of the main converter. By this means the field current is varied to correspond with the load and power factor. The connections for the converter and its auxiliary are shown in the adjoining diagram.—Lond. *Elec.*, Aug. 9.



CONNECTIONS BETWEEN ROTARY CONVERTERS AND BOOSTER.

Rosenfeld and Zelenay System of Electric Traction.—GERARD.—A description of their so-called "tangential traction" system. It can only be operated economically on very high-speed railways, the

trains running at least 60 miles an hour. For speeds below this, the system is unsuitable and would be very costly. In addition to the ordinary rails, a second pair of light and insulated rails is laid between them, about 27 inches apart. Along the center of the line rectangular blocks of laminated iron are fixed in the ballast at intervals of 55 yards. The length of each block is 11 yards. The blocks are arranged at a certain distance apart, owing to the prohibitive cost of a continuous series. These blocks are wound with a three-phase winding, and may be regarded as constituting the stator of an induction motor. What corresponds to the rotor is a similar block of laminated iron, fixed on the axles of a truck that runs on the insulated rails, the said truck being beneath the main body of the car, and attached to it by hooks and chains. The winding of the rotor block is under the control of the driver, who can insert resistances at will. The air gap between rotor and stator is about two-fifths of an inch. When the stator blocks are excited by current from the power house, they exert a horizontal pull on the rotor blocks, which sets the train in motion. The propelling force on the train becomes practically very small unless the rotor block is immediately over a stator block, and the driving force is applied in jerks and not continuously. The line is divided into sections of 550 yards, and only that section is excited on which the train is passing, the switching being done automatically by the train. The author gives an estimate for running trains at high speeds on this system, and according to these figures the system would be cheaper than the ordinary direct current system. An experimental line is to be constructed.—*Soc. Belge Elec. Bull.*, 18, Feb.; abstracted in *Science Abstracts*, July.

High-Speed Electric Traction.—REYMOND-SCHILLER.—Continuations of his article, the first part of which was abstracted in the Digest, June 1. He makes some critical remarks on several new systems of traction, especially on the Langen suspended railway and the Behr monorail railway. He does not believe that they are suitable for high-speed electric railways. He recommends not to look for new extraordinary systems, but to work out the best solution for a double-track railroad, similar to the present standard railroads. He endeavors to show that on such a railway indeed a speed of 250 kilometers (155 miles) per hour can be attained. He recommends a gauge of 4½ meters (nearly 15 ft.).—*Zeit. f. Elek.*, June 30, Aug. 4.

REFERENCES.

Permanent Way for Electric Tramways.—HOWARD-SMITH.—An illustrated paper read before the Ass'n of Munic & Corpn. Engineers at Leicester, on track construction. He discusses the construction of the rails, the standard rail section, rail lengths, rail joints, the design of wheel tires, the life of rails, and the cost of construction. An account is also given of the discussion which followed.—Lond. *Elec. Eng.*, July 19, Aug. 9.

Paris.—KOHLFUERST.—An illustrated description of the large electric railways in Paris. The road from Quai d'Austerlitz to Quai d'Orsay, of the Orleans Railway, and the Metropolitan Railway.—*Zeit. f. Elek.*, June 16, 23, 30, July 7.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Australia.—A table, with a brief article, of the electric supply stations of Australia, giving information about various items. It appears that the electrical industry is rather backward in Australia, as in the whole of that continent there are only 27 towns that have electric supply stations. In Sydney, with a population of over 426,000 inhabitants, only one station of a capacity of 625 kilowatts has been installed.—*Austral. Hardware and Mach'y*, June 1; Lond. *Elec.*, Aug. 9.

REFERENCE.

Brooklyn.—An illustrated description of the Kings County Station of the Edison Illuminating Co., of Brooklyn.—*Elec. Rev.*, Aug. 17.

ELECTRO-PHYSICS AND MAGNETISM.

Spectrum of Hydrogen.—PARSONS.—There are two distinct spectra of hydrogen, one the "four-line spectrum," consisting of some 15 lines, four of which are in the visible part of the spectrum, the other the "compound spectrum," consisting of more than a hundred lines. He gives a preliminary account of experiments, for which he built a storage battery of 2000 cells. The discharge was sent directly through a vacuum tube, having a capillary of about 1 mm. diameter, with a water resistance of about 1½ megohms in series. He intends to double the number of cells. In experiments with a tube of 4 mm. internal diameter and electrodes of heavy aluminum wire about 1 cm. apart, an induction coil being used without spark-gap or condenser in the secondary circuit, the color of the discharge was red, and it was less than a millimeter wide. The introduction of the spark-gap and condenser greatly increased the diameter of the red discharge and also the intensity of the four lines. At lower pressures without capacity, a blue glow discharge could be obtained. The observations show that the intensity of the four lines is in some way intimately associated with the intensity of the red discharge, and further that the introduction of capacity always has a tendency to increase the red in the discharge, and under certain pressure conditions to change the blue discharge into the red. The battery gives essentially the same spectrum as the induction coil without the condenser.—*John Hopkins Un. Circ.*, v. 20, No. 152, May-June.

REFERENCES.

The Electric Spark and Its Spectrum.—SCHENCK.—An account of an investigation, the object of which was to divide the principal lines in the spark spectrum of cadmium into three groups, each having characteristics peculiar to itself, and to study some of the properties of the spark and its spectrum by means of photographs taken with a revolving mirror.—*Johns Hopkins Univ. Circ.*, vol. 20, No. 152, May-June.

Zeeman Effect.—KENT.—Some "Notes on the Zeeman effect." He gives an account of an investigation in which he extended Reese's investigations on zinc using higher field strengths. He also made a more exhaustive investigation of the spectrum of iron.—*Johns Hopkins Univ. Circ.*, vol. 20, No. 152, May-June.

ELECTRO-CHEMISTRY AND BATTERIES.

Storage Batteries of Other Metals Than Lead.—VON LASZCZYNSKI.—An article on several storage batteries, invented in recent years, which consist of other metals than lead, especially on the cells of Jungner, Michalowski and Edison. He thinks that Jungner's suggestion to use peroxide of silver as a depolarizer is not a bad one, but that silver is too expensive. Michalowski's suggestion to use peroxide of nickel as material of the positive electrode is very good for the reason that the formation of Ni_2O_3 from 2 NIO and O is an endothermic reaction, i. e., this reaction occurs with absorption of heat. When, therefore, in the discharge of the battery the reverse action takes place and electrical energy is produced, this fact is of the greatest importance for the e. m. f. of the cell, as may be seen from a comparison of two cells, both having hydroxyde of potassium as electrolyte and zinc as negative electrode, while in the one cell cuprous oxide is used for the positive electrode, and in the other peroxide of nickel. The e. m. f's of both cells can be calculated by Thomson's rule from the heat-tonings of the chemical processes. To the formation of zincoxide from zinc and oxygen corresponds an e. m. f. of 1.80 volts. This refers to both cells. (He does not take into account the formation heat of zincate, which he ought to do.) The reduction of cuprous oxide to pure copper corresponds to a negative e. m. f. of —0.95 volt, while, for the reason mentioned above, the reduction of peroxide of nickel to nickel oxide corresponds to a positive e. m. f. of + 0.04 volt. Hence the e. m. f. of the zinc-copper cell is $1.80 - 0.95 = 0.85$ volt, and that of the zinc-nickel cell is $1.80 + 0.04 = 1.84$ volts, which is in good agreement with measurements. (This result becomes quite clear when expressed in terms recently introduced by Reed. "Electrogenic" for those reactions in which chemical energy is changed itno electrical energy, and "electrothanic" for those in which electrical energy is changed into chemical energy. The former represents a positive e. m. f., the latter a negative one. In the zinc-copper cell the reaction at the zinc electrode is electrogenic, that at the copper electrode electrothanic, hence we get a difference of two e. m. f.'s. In the zinc-nickel cell the reaction at both electrodes are electrogenic, hence we have here a sum of two e. m. f.'s). Both the oxide and peroxide of nickel are said to be entirely insoluble in alkaline lyes. It is, however, not enough to know this very favorable property of nickel, when used as positive electrode, but a method must be found by which an active nickel oxide electrode can be made. It is not sufficient to cover the positive electrode (a copper plate or something similar) with a paste of nickel oxide. "One could just as well cover it with sand or powdered glass." (He evidently means that the structure of the active mass must be such that a large surface is always in contact with the electrolyte so that the chemical reactions can take place. This is not the case when a paste of the active material is simply put around a sheet of, say, copper, and then dried.) After a few remarks on unsuccessful attempts to prepare good peroxide of nickel electrodes, he describes the following one, which he thinks to be the

most promising for future development. An alloy of nickel and zinc is electrolytically deposited on a network of very fine nickel wire. After electrolysis, this is placed in a concentrated alkali lye, local action takes place, the zinc being dissolved and hydrogen being developed. In this way the zinc is removed and a firm compact framework of nickel is produced with molecular pores where the zinc had been. These pores are then filled by a special process with nickel oxide. Such plates can be compared to both the Plante type and the grid type of lead plates. There is here a grid, namely, the porous nickel, but the meshes are of molecular dimensions so that "nearly every molecule of nickel oxide is in contact with the bearing." The plates behave therefore like Plante plates, they can be charged and discharged at high rates. The capacity obtained with them "is 25 ampere-hours per kilogram of positive electrode, with a discharge current of 20 amperes" (no dimensions of the cell being given), each electrode consists of several such layers of network. Edison uses also a higher oxide of nickel as material of the positive electrode in his new battery, but he prepares the electrode by quite a different and very simple method. The present author raises the following objections to Edison's method. "The model was probably the preparation of most of our present dry cells, in which a compressed mixture of graphite and pyrolusite serves as depolarizer. We know, however, that even the best of these cells are not constant, and fail at latest after two hours, when discharged with 2 amperes per kilogram of positive electrode. A rest of 24 hours is necessary before another discharge can be made. They would certainly fail usually after a few minutes, if the pyrolusite mixture had been compressed hydraulically, because the electrolyte could not enter into the interior of the anode. One therefore applies to the mass only a rather light pressure which is just sufficient to ensure that the mixture is not a loose powder. A slightly compressed mixture of nickel oxide and graphite, however, is burst during the charge by the developing oxygen, and a loose powder is obtained which has no capacity. It makes also a great difference whether such an electrode is used as depolarizer in a solution of chloride of ammonium or in hydroxide of sodium. The solution of chloride of ammonium dissolves the protoxide of manganese reduced during discharge, so that the particles of the dioxide which have not yet been consumed, are uncovered and the cell recovers. This is not the case with hydroxide of sodium, as the protoxide of manganese which is a poor conductor, remains at its place and covers the dioxide. The case should be similar with the graphite-nickel peroxide electrode. Finally, it is very doubtful whether the graphite is able to resist continually against nascent oxygen in alkaline lye. What we know so far makes it very doubtful." The author agrees, however, that the higher oxide of nickel is a very suitable material for the positive electrode, and that its practicability has been proven beyond doubt. This is not the case with the material of the negative electrode. He first discusses the use of zinc. A cell with hydroxide of potassium or sodium as electrolyte and with a zinc electrode and an electrode of peroxide of nickel has an e. m. f. of 1.84. It acts well as a reversible cell, results of tests being given, but it is necessary to have a large amount of electrolyte. This makes this cell heavy and unsuitable for automobiles, etc. He then discusses the type of cell in which the electrolyte is not changed at all, and the process during charge and discharge consists in the transport of oxygen from one plate to the other. The first cell of this type (1896) seems to be a cell of Pollak with compounds of iron used for both electrodes (see ELECTRICAL WORLD AND ENGINEER, July 6, page 25). Other examples are Jungner's (1898) copper-silver cell and cadmium-silver cell, and Edison's new nickel-iron cell. The present author doubts whether iron is a suitable material for the negative electrode. He then describes a cell which he has designed. He uses a nickel oxide plate and a zinc plate, covered with a paste of zinc carbonate and water, in a solution of carbonate of potassium. When this cell is charged, at one end metallic zinc is formed and at the other peroxide of nickel while the carbonate of potassium is changed into bicarbonate of potassium. During discharge the reverse action takes place, the e. m. f. is 2.10 to 2.20 volts. This cell is theoretically interesting, but practically of no value, because nickel dissolves in a concentrated solution of bicarbonate, which results finally in local action at the zinc.—*Zeit. f. Elektrochemie*, Aug. 8.

The Influence of the Temperature of the Acid Upon the Capacity of the Lead Accumulator.—M. U. SCHOOP.—An illustrated account of an experimental investigation, in which he has reached the following results. Heating of the acid can be regarded as a means of increasing the capacity of a lead accumulator. This increase of capacity is due, first, to the increase of the conductivity of the acid, and, second, to an increase of diffusion. The efficiency is also increased. The peroxide plate takes a larger share in the increase of capacity than the lead plate. The increase of capacity which is obtained by heating the acid, is the greater, the thicker the electrodes and the smaller the porosity of the active material and the greater the discharge current density and the greater concentration of the acid used. When after a discharge with heating of the acid, the battery was charged again at normal temperature and then discharged also at normal temperature, the capacity obtained was much too small on account of formation of sulphate on the spongy lead plates. He remarks that until detailed investigations have been made he cannot recommend to use in practice heating of the acid as a means of increasing the capacity. Experience shows that batteries in warm rooms have a much shorter life than batteries placed in rooms of normal temperature.—*Zeit. f. Elek.*, July 21, 28.

REFERENCES.

E. M. F. Between Adjoining Electrolytes.—SACKUR.—It is known that the e. m. f. between two different concentrations of an aqueous solution can be greatly diminished by an "electrolytic short circuit," namely, by the addition, to both sides, of a solution of an electrolyte with the same positive ion. A mathematical theory of this case has been developed by Abegg and Bose. The present author has made an experimental investigation, the results of which are in fair agreement with the theory.—*Zeit. f. Elektrochemie*, July 18.

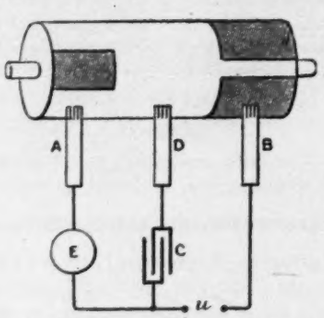
Electrolysis of Mixed Solutions of Iron and Nickel Sulphates.—KUESTER.—A German Electrochem. Soc'y paper, giving an account of an experimental investigation of the simultaneous deposition of iron and nickel from the mixed solutions of the sulphates.—*Zeit. f. Elektrochemie*, June 6.

Dissociation of Strong Electrolytes.—SACKUR.—An article on the disagreement between Ostwald's law for the influence of the concentration upon the conductivity and the results of measurements in the case of strong electrolytes. John's investigations in which he tried to settle this disagreement, are discussed in detail. But it is evident that this question has not yet been settled.—*Zeit. f. Electrochemie*, July 18.

Ozone.—A summary of recent developments in the ozone industry. Descriptions, mainly taken from patent specifications, of quite a number of new apparatus and processes are given.—*Zeit. f. Elektrochemie*, July 18.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Plotting Alternating Waves.—HOSPITALIER.—An illustrated description of a new instrument devised by him, for plotting the wave form of an alternating current, or e. m. f., or power, etc. He calls his instrument "ondographe" or "cymatographe." It appears to be simpler than all similar instruments. It traces directly a continuous record of the wave form on a slip of paper. It works very quickly, giving the record of a wave in 10 to 30 seconds, while, for instance, the Callendar cycle-curve recorder requires an hour for the same purpose. The instrument is based upon the principle of Jou-



PLOTTING ALTERNATING WAVES.

bert's method of plotting the wave form by means of instantaneous contacts, the different points of the wave being obtained by making the contact at moments corresponding to different phases. The different parts of the new instrument are the following: A synchronous motor, driven by the source of e. m. f., the wave of which is to be traced. This motor drives the commutator by means of a train of

gearing, of such design that when the motor makes n revolutions, corresponding to n periods, the commutator makes only $n-1$ revolutions. The commutator consists of a cylinder of insulated material covered by a copper or brass tube, of which certain parts are cut away, as will be seen in the adjoining diagram which shows the connections: u are the points at which the electric phenomenon takes place, the wave form of which is to be plotted; C is a condenser, E is the registering apparatus, A B D are three brushes; the operation consists of two steps. In the first step the condenser is charged, in the second it discharges through the measuring instrument. The measuring instrument may be any form of the moving coil type, for instance, a Weston instrument. The record is plotted on a revolving cylinder.—*L'Ind. Elec.*, July 10; another description by Blondin, of the instrument in *L'Eclairage Elec.*, July 13.—A nice and interesting series of records of waves, obtained with the new instrument, is given in *L'Ind. Elec.*, July 25.

Quadrant Electrometer.—DOLEZALEK.—A description of a simple and very sensitive quadrant electrometer. The needle or needles in this quadrant electrometer are made of silver paper for lightness and are suspended on a quartz fiber. After the fiber has been attached to its end fastenings by sealing-wax, it is dipped into a solution of hygroscopic salt, such as calcium or magnesium chloride. The fibre and wax thus get a thin coat of the salt which always contains sufficient moisture to make the surface conducting so that the needle can be charged along the fiber. The instrument can be made extremely sensitive by choosing a fine fiber. With the needle charged to 110 volts and a fiber 0.009 mm. diameter, the period of the needle was 18 seconds and the sensitiveness 0.1 scale divisions at 2 meters distance for 0.00004 volt.—*Deutsch. Phys. Ges. Verh.*, 3, 2, p. 18, 1901; abstracted in *Science Abstracts*, July.

Energy Measurements with Approximate Methods.—STERN.—An article in which he first discusses the error of a "three-wire" meter for measuring the energy of a three-wire system. The fixed main coils of the meter are inserted in the outer conductors of the three-wire system, while the shunt coils are connected across the outers. He shows that the maximum theoretical error of a three-wire meter, in per cent, is about half the voltage difference of the two halves of the system, in per cent. He then discusses at some length induction meters, based upon Ferraris' principle. They can only be considered as approximately correct. He shows this analytically.—*Elek. Zeit.*, July 18.

REFERENCE.

Measuring the Resistance of Storage Batteries.—BRUGER.—An illustrated description of a quick and rather exact workshop method for measuring the internal resistance of storage batteries.—*Centralblatt. f. Accum.*, July 15.

TELEGRAPHY. TELEPHONY AND SIGNALS.

REFERENCES.

Cleveland.—An illustrated description of the new Western Union Telegraph plant in Cleveland.—*West. Elec.*, Aug. 10.

Wireless Telegraphy.—A note on experiments with wireless telegraphy in recent naval manœuvres in the Mediterranean. Wireless telegraphy proved very successful for quickly transmitting messages to ships scattered over a wide area.—Lond. *Elec. Rev.*, Aug. 9.

British Telephone Exchange.—An illustrated description of the Tunbridge-Wells Telephone system, the number of subscribers being 330.—Lond. *Elec. Eng.*, Aug. 2.

Loud-Speaking Telephone.—KREJSA.—An illustrated description of the Roeder-Oprendak loud-speaking microphone. The arrangement of the induction coil differs from that ordinarily used.—*Zeit. f. Elek.*, June 23.

MISCELLANEOUS.

REFERENCES.

Westinghouse Electric Co. in Great Britain.—Articles on the proceedings at the laying of the corner-stone of the Westinghouse Works, at Trafford Park, Manchester.—Lond. *Eng'ing, Elec. Rev., Elec. Eng.*, Aug. 9.

British Manufacturing Plant.—A description of the British Thomson-Houston Co.'s manufacturing plant at Rugby, which is now nearly completed.—Lond. *Elec. Eng.*, Aug. 9.

German Manufacturing Plant.—In a continuation of the serial on the recent visit of the British Inst. of Elec. Eng. to Germany, a well illustrated description of the dynamo works of Siemens & Halske is given.—Lond. *Elec.*, Aug. 9.

Glasgow Exhibition.—A continuation of the illustrated serial, giving brief descriptions of a small ship-lighting set, two small induction motors, and two direct-current generating sets, all of British make.—Lond. *Elec.*, Aug. 2.

An illustrated description of several steam generating sets. All the dynamos described generate direct current.—Lond. *Elec. Rev.*, Aug. 9.

New Books.

A HAND-BOOK FOR APPRENTICED MACHINISTS. By Oscar J. Beale. Providence, R. I.: Brown & Sharpe Manufacturing Company. 141 pages, illustrated. Price, 50 cents.

The opening sentence of the preface is as follows: "This book is for learners in the use of machine tools, and is the outgrowth of the needs of the Brown & Sharpe Manufacturing Company in the instructing of apprentices." In view of this announcement, it is only natural that the book should be to some extent an advertisement of the Brown & Sharpe Company, but this does not alter the fact that it is an excellent book for apprentices.

Attention is called in the preface to the difference between knowledge and skill. "Skill is largely a matter of labor and time—of unwearied labor and much time." "There are, however, important points in the use of machine tools that are more matters of knowledge than skill. This book aims to present a few of these points, which should be learned early and remembered late." We think the book has succeeded in this laudable purpose. First, there are some excellent instructions for the proper handling of machine tools, with regard to the personal safety of the operator and the safety of the tools themselves. By using reasonable care a machinist may work to a good old age without being hurt, yet by a single careless act, like one described in the book, he may be instantly killed.

The book goes on to explain how to do different kinds of work, and—what is quite as important for beginners—how not to do it. One cut will show a piece of work properly executed, while several other cuts show the same piece of work with various mistakes selected from those most frequently made by apprentices. Although this book is intensely practical, we find the following statement in the chapter on signs and formulas: "Formulas will express more on a square inch of paper than words on a whole sheet. The meaning of formulas is clearer also, and they can be understood more quickly than words." It is refreshing to mark the growing confidence of practical mechanics in the utility of simple algebra. In the not very distant past anything approaching to algebra was regarded by most practical mechanics as a sort of pedantic fad; something to be avoided by the practical man who has serious work to attend to, as he would avoid a contagious disease.

The editor modestly states in the preface, speaking of the book, "It does not aim to take the place of the excellent engineers' pocket-books already published, some one of which an apprentice should obtain. He should also subscribe for a mechanical paper." We think the book fulfills the purpose for which it was written, and we recommend it to young machinists.

HANDBUCH DER ELECTROTECHNIK. Elektromotoren und Electrische Arbeitsubertragung. Neunter Band. Von F. Nethammer und E. Schultz. Leipsiz: Verlag von S. Hirzel. 416 pages, 356 illustrations. Price, 18 marks.

This is the ninth of an as yet incomplete series of volumes intended to review the whole field of modern electrical practice. No less than 15 prominent German authorities are co-operating toward this end, the present book being written by Dr. Neithammer and Mr. Schultz. According to its title, it should treat of electric motors and the electrical transmission and application of energy. The transmission portion is, however, not touched upon, this being reserved for another volume. Neithammer has written of the motors themselves, but his work is in part overlapped by Schultz, who also handles the application of motors to various pieces of machinery.

The theoretical portion of the volume is handled in a gratifyingly clear and simple manner, the relations between weight, speed and capacity being concisely explained, as are also the questions of sparking, starting and regulating. Naturally alternating current motors are the subject of more extended mathematical treatment, owing to the greater diversity of types and the greater complication of their theory and principles. It is not claimed that there are

any new contributions toward either, but the whole forms an excellent recapitulation of the best and most recent literature on the subject.

The manufacturers of both direct and alternating-current motors have been liberal with photographs, cross sections and descriptions of their various machines, and while none of these go into detail the pages devoted to them should be of much interest to others in that line. Of course, German apparatus receives almost exclusive mention.

The portion of the work devoted to motor-driven machine tools contains but little of interest. Not only is there nothing novel, but many applications common in the United States are not mentioned at all. From those that are it would seem that the European manufacturers had to learn from us not we from them.

In conclusion, the reviewer wishes to offer a gentle but firm protest against the use of the word "Handbook," to describe a volume measuring 8 by 11 by 1½ inches, and weighing in the neighborhood of 6 lbs., these dimensions being too great for even the quart size hip-pocket indulged in by some members of the fraternity. As a reference work, the series is most valuable, and should find a place in the bookcase of every engineer. It is to be regretted that there is no similar series printed in English.

ELECTRICAL TRADES DIRECTORY. Handbook for 1901. Nineteenth year. London: "The Electrician" Printing & Publishing Company. 1354 and 125 pages. Price, postpaid, 15 shillings.

The 1901 edition of this extremely useful handbook contains 1354 pages of text, not including a biographical division of 125 pages in the form of an appendix. Much new matter has been introduced, particularly in the legal section and the section on "Standard Forms of Accounts." The directory section has also been much enlarged, particularly in the British and colonial divisions. Two huge sheets giving the data of all British central stations and electric railways are contained in a pocket in the back cover of the volume.

One of the most valuable sections of the Directory for other than British readers is the directory of professions and trades connected with electricity and its application, which covers the entire world. That for the United States occupies 37 closely-printed pages and includes the names and addresses of more than 1500 electrical engineers and manufacturing companies. Each division of the Directory is in two sections, one alphabetical by names and the other classified according to branches of the industry. The Continental section is still more extensive, including not far from 3000 names and addresses. Other divisions of the Directory aside from the British and those above mentioned are a colonial division, an Asiatic division and a Central and South American division. In addition, the names are given of all the officials connected with the electrical departments of the principal governments of the world. The biographical section contains biographies of several hundred of the leading electrical engineers and physicists of the world, many of the sketches being accompanied by portraits. We note that not a few American names are included. An obituary section contains biographical sketches of prominent electrical engineers, and members of the electrical industry who have died during 1901.

An immense amount of miscellaneous information of interest to those engaged in electrical pursuits is contained in the first part of the book, there being about 250 entries in the contents of this department, which covers more than 500 pages. Among the subjects covered are the submarine cables and the cable fleet of the world; the underwriters' rules of the more important countries; a digest of British and foreign tariffs on electrical apparatus, etc.; the officers of the leading electrical and scientific societies of the world; a directory of directors of British electrical companies and financial particulars of the same. About 50 pages are devoted to electrical data, such as tables of fuse constants and sparking distances, copper wire tables, steam tables, etc. One section is devoted to the patent rules of Great Britain and foreign countries. A list appears of the British electrical patents expiring in 1901, which includes many patents granted to Americans.

As will be seen, the volume forms a surprisingly complete compendium of information useful to those engaged in electrical pursuits. It is, however, open to the objection that the matter is thrown together with little regard to arrangement. A more careful selection of subjects and some attempt at condensation would, we believe, greatly decrease the size of the book without greatly detracting from its value.

BOOKS RECEIVED.

ELECTRICAL TRADES DIRECTORY. Handbook for 1901. Nineteenth year. London: "The Electrician" Printing & Publishing Company. 1354 pages. Price, postpaid, 15 shillings.

LES AUTOMOBILES ELECTRIQUES. By Gaston Sencier and A. Delasalle. With a preface by Charles Jeantaud. Paris: Vve. Ch. Dunod. 390 pages, 192 illustrations. Price, 15 francs.

Directory of Electrical Societies, Etc.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, New York, Oct. 9, 10 and 11, 1901.

ASSOCIATION OF THE EDISON ILLUMINATING COMPANIES. Next meeting, Buffalo, Sept. 10, 11 and 12, 1901.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Niagara Falls, N. Y., Sept. 2, 3 and 4, 1901.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Rochester, N. Y., Sept. 10 and 11, 1901.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Montreal, Que., Sept. 11, 12 and 13, 1901.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, York, Pa., October, 1901.

An Electric Voting Machine.

An electric voting machine is on exhibition in Indianapolis, Ind. If the voter has cast a ballot for one man for each office without having made a mistake, a bell on the machine rings automatically. If the voter has made a mistake, the bell is silent. The machine is operated by electricity, and is attracting favorable attention at the hands of the commission selected by the Governor to procure voting machines. The machine is made by the Electric Ballot Box Company, of Petersburg, Ind.

Effects in Church Lighting.

There is more and more seen a tendency to improve effects in church illumination by using electricity. The "dim religious light" of other days is still admired and has its due devotional effect, but the greater modern ability to secure adequate lighting by means of electricity is now thoroughly recognized by ecclesiastical authorities. In regard to this matter, the *Baltimore American* has the following interesting item:

Mr. S. F. Gray, a local electrician, has just completed what is probably the most beautiful electrical display ever seen in a church in the city. It is the illumination of the statue of Our Lady of Lourdes at the Cathedral. As is well known, especially among Catholics, Our Lady of Lourdes was an apparition which appeared before the child, Bernardette Soubirons, about February, 1858, on a rock at Lourdes. Since then Lourdes has become famous the world over for a fountain, the water of which is said to possess most wonderful healing qualities, and which spring was revealed after the child had dug into the sand at her feet at the command of the apparition. Two magnificent churches have since been built near the fountain, which is visited by many thousands annually to receive the benefit of the water. Many miraculous cures are attributed to the properties of the water. The apparition appeared to the child on 18 different occasions, and a statue of Our Lady of Lourdes stands on the left side of the altar at the Cathedral. The statue is of Italian marble. On its head is a magnificently designed brass crown studded with tiny incandescent bulbs. The roses about the feet of the apparition, so the story of Bernadette goes, grew out of the rocks in a day to convince the Bishop of Lourdes of the truth of the child's statement. These roses on the statue are made of Austrian porcelain, while the leaves are of brass and remarkably natural in appearance. Inside each rose is small bulb, the soft rays of which contrast most beautifully with the brilliant illumination of the circle about the head of the statue upon which are inscribed the words: "I am the Immaculate Conception." The lettering is of gilt and lends additional splendor to the brilliancy of the lights. Each group of lights about the statue can be used separately. The display was designed and executed by Mr. I. P. Frink, New York.

American Incandescent Lamp Company.

The American Incandescent Lamp Company, of York, Pa., proposes to manufacture the "American" lamp, and has as its officers, Mr. E. K. McConkey, as president, and Mr. Paul McJunkin, as general manager. The product will not embody any radical departure from the present best practice in the manufacture of incandescent lamps, but the company relies upon a perfected system of automatic machinery, and great care in the production of the lamp. The works manager has had experience in charge of the technical work of one of the largest factories for a considerable time, and the present equipment will consist of apparatus designed by him since leaving there, and perfected in the company's own experimental laboratory.

The American line will include, at present, all the standard types and sizes of lamps adapted for use on regular lighting circuits and for the ordinary sockets, i. e., 50 to 250 volts and 2 to 150 candlepower. The factory is being equipped for an output of 1000 per day, at the start, and is to be ready in time to take advantage of the winter trade, which promises to be excellent. Mr. McJunkin says: "We shall not start until we are sure that everything is in the desired shape for turning out our best product, and without more delays than are absolutely unavoidable, for we expect to build up a reputation as being a firm who either keep their word or do not give it."

Morse Twist Drills at Buffalo.

The exhibit of the Morse Twist Drill & Machine Company at the Pan-American Exposition at Buffalo occupies space 43 in Machinery Building, and is displayed in three cases representing every department in its factory. The cases include twist drills of various sizes, and special attention is called to the large display of oil drills of their special pattern, with holes through the solid stock, oil sockets, three-groove chucking reamers, chucks, various kinds of formed cutters and milling cutters, straight and taper reamers, mandrels with expanding sleeves, gang cutters, cutters with radial grooves, plug, ring and wire gauges, counterbores, countersinks, taper pins, screw-slotting cutters, end mills, cutters with spiral teeth, taps, dies and screwplates. The largest drill exhibited is 5 inches in diameter, and the smallest drill, No. 80, is .0135 of an inch in dimeter.

This company has had exhibits at and received medals from the following international expositions: Vienna, 1873; Philadelphia, 1876; Paris, 1878; Melbourne, 1880; Paris, 1889; Chicago, 1893; Brussels, 1897; Paris, 1900; also for exhibits at Boston, 1865, 1869; New York, 1874; Cincinnati, 1879; Atlanta, 1895.

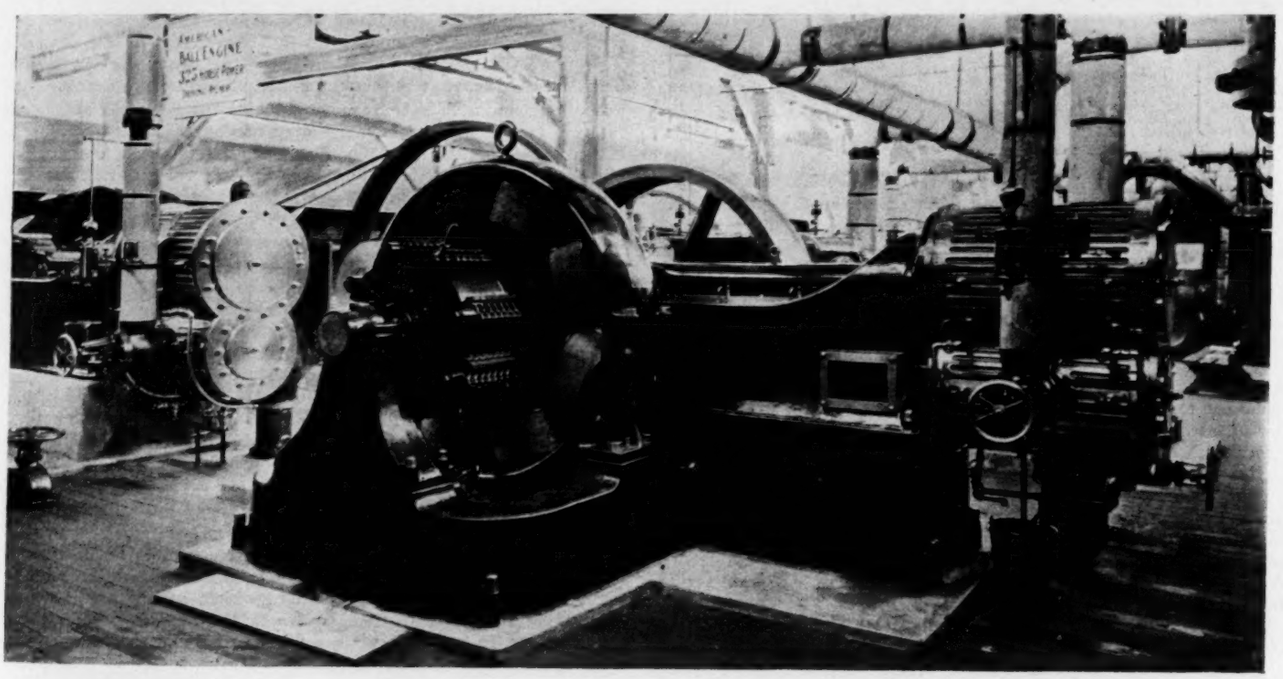
Electrical Engine-Stop System.

An application of electrically-operated control for the steam engine at the Buffalo Pan-American Exposition is shown in the Monarch engine-stop system, applied to the Fitchburg engine in the pumping plant. This engine is 18 inches by 42 inches, developing 225 horsepower at 87 r. p. m., operating one of the Root's rotary pumps. The Monarch is the only safety system connected directly with the throttle-valve of the engine. It is operated by electricity and gravity combined. The electric part of the device serves to connect as many different parts of the plant as may be desired, near or remote, with the throttle valve, by means of push buttons. Pressing the button at any point in case of accident will unlock the system, closing the throttle valve by gravity, and in much less time than the engineer could do it were he at the throttle.

The automatic speed-limit used in the Monarch system is connected with the main, or flywheel, shaft of the engine, and can be set at any desired number of revolutions of the engine above the normal, and operates only in case of increased speed above that point at which it is set. If any part of the regular governor breaks, or fails for any reason to control the speed of the engine, the speed limit instantly operates the stop automatically by electric contact, which immediately closes the throttle, thus absolutely preventing the engine from racing. The apparatus is made by the Monarch Manufacturing Company, of Waterbury, Conn.

American Engine Company's Pan-American Exhibit.

One of the most notable of the steam and electric exhibits at the Pan-American Exposition is that of the American Engine Company, of Bound Brook, N. J. A view of the main display is herewith presented. The largest plant installed by the concern comprises a 325-hp engine, driving one of the fountain pumps by belt. A smaller plant is a 200-hp American Ball engine driving a 125-kw generator of the same make. This unit furnishes current around the fountain but is also used to charge the batteries for the fleet of electric launches. The results obtained are eminently satisfactory, and the exhibit attracts deserved attention. It is worthy of note that the first duplex compound engine of the company was shown at the electrical exhibition in Madison Square Garden in 1898, since when its popularity and use have become widespread. Their multipolar dynamos and motors are also well known in the art, and a great many direct-connected units of this type are now being installed.



ENGINE AND GENERATOR EXHIBIT AT PAN-AMERICAN EXPOSITION.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call loans ranged between 2@3 per cent, 2¼@2½ per cent being the selling quotation, and time money was held at 4½ per cent and 4½@5 per cent for longer periods. Mercantile paper is quoted at 4½ per cent for prime double names. The stock market exhibited a better tone and greater activity, although the volume of trade was narrow. The more favorable crop reports, continued good railway earnings and the growing belief that the steel strike will soon end, created renewed confidence in the market. The steel stocks closed higher, although they were irregular at the beginning of the week. There was no special activity in any of the other industrial stocks. Brooklyn Rapid Transit had support and was the object of bull tips. Following are the closing quotations of Aug. 26, compared with those of the previous week:

NEW YORK.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug. 27.
American Tel. & Cable..	—	—	General Carriage.....	⅞	¾
American Dist. Tel.....	—	—	Hudson River Tel.....	120	120
Brooklyn Rapid Transit..	74¼	75¼	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	—	—	Metropolitan Street Ry...	166	167¼
Electric Boat.....	18	19	N. E. Elec. Veh. Tran...	—	—
Electric Boat pfd.....	40	48	N. Y. Elec. Veh. Tran....	10¼	10½
Electric Lead Reduc'n..	1½	1½	N. Y. & N. J. Tel.....	168	168
Electric Vehicle.....	5½	5	Tel. & Tel. Co. of Am....	3	3
Electric Vehicle pfd.....	10	10	Western Union Tel.....	93⅛	93
General Electric.....	263	265½			

BOSTON.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug. 27.
Am. Tel. & Tel.....	161	164½	Mexican Telephone.....	2⅜	2½
Cumberland Telephone...	—	—	New England Telephone.	—	—
Edison Electric Light...	*256	250	Westinghouse Elec.....	—	—
Erie Telephone.....	48	45	Westinghouse Elec. pfd..	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug. 27.
American Railways.....	40	40	Phila. Traction.....	95¼	97½
Electric Storage Battery..	75	74	Philadelphia Electric....	5	5⅜
Elec. Storage Batt'y pfd..	75	74	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America....	7¼	7⅜	Pa. Elec. Veh. pfd.....	¾	¾

CHICAGO.

	Aug. 19.	Aug. 27.		Aug. 19.	Aug. 27.
Central Union Telephone.	—	—	National Carbon pfd.....	83	84
Chicago Edison.....	155	162½	Northwest Elev. com.....	36	38
Chicago City Ry.....	201	209	Union Traction.....	15½	17⅜
Chicago Telep. Co.....	*273	268	Union Traction pfd.....	59	60
National Carbon.....	17	17			

*Asked.

GENERAL CARRIAGE COMPANY.—O. F. Thomas has been appointed receiver of the property in this State of the General Carriage Company, whose office is at 135 Broadway, and place of business at Forty-third Street and Sixth Avenue, New York, by Judge O'Gorman, of the Supreme Court, in a suit brought by Henry C. Hepburn, holder of 100 shares of stock, in proceedings for the voluntary dissolution of the corporation. The receiver's bond was fixed at $5,000. A meeting of the executive committee was held on the 8th inst., the minutes of which show that it was stated that it was impossible to continue the business in its present condition, as an attachment for over $4,000 had been placed on the company's property here, a second attachment for $11,000 was placed on its cabs sent to Chicago for repairs, and a third attachment for $45,000 was obtained against the company here on the 7th inst. A resolution was adopted by the committee that it is desirable in the interests of the stockholders that a receiver be appointed. An order was filed in the Court of Chancery at Trenton, N. J., appointing William C. E. See receiver of the General Carriage Company, a New Jersey corporation. The receiver was appointed at the instance of Montgomery & Co., to whom the company is indebted to the extent of $120.71. The application for the appointment of a receiver alleged that an attachment for $400,500 against the company is now in the hands of the Sheriff in New York City. It was also ordered that the company show cause at Jersey City on Aug. 26 why the appointment of Mr. See as receiver should not be made permanent.

CENTRAL UNION TELEPHONE.—The directors of the Central Union Telephone Co. have issued this statement: "It is the opinion of the directors that the money necessary for the present rapid development of the company's property should be secured by reducing the present issue of capital stock one-half and then increasing the capital stock so reduced, 100 per cent, which will bring into the treasury substantially $3,500,000 in cash. Immediate steps will be taken to bring the matter before the stockholders for the necessary action on their part." Inasmuch as the directors representing the Bell Telephone control enough stock to carry the proposition the announcement of the plan by the board of directors is tantamount to its enforcement. It is understood that the Bell interest has taken a large part of the stock sold recently on the Chicago Exchange, and that the objectors to the plan of assessment in any form have been the sellers. The company has outstanding $6,962,100 stock. The value of the stock after the reduction and the increase have been completed ought to be about 97. The price now rules around 47.

TO REDUCE CAPITAL STOCK.—Stockholders of the Railways Company General have received notice that, owing to shrinkage in the value of assets, the general stock is to be reduced. A special meeting has been called for Sept. 30, at which will be submitted the proposition to reduce the outstanding capital from $1,500,000 to $1,200,000 by exchanging four new shares, each of the par value of $10, for each 10 of the present shares, the par value of which is $5. The Railways Company General was organized three years ago, with L. M. Downs as president, J. M. McAfee vice-president and Taylor Faunce secretary and treasurer. It acquired the Newtown Electric Railway, and later the Lewisburg, Milton & Watsontown Passenger Railway Company, the Montoursville Passenger Railway Company and the Michigan Traction Company. The assets are figured as follows: $510,000 bonds, $250,000 stock and $395,000 cash and notes on hand.

INTERNATIONAL POWER COMPANY.—If there is a more liberal charter than the one granted by the Connecticut State Legislature to the International Power Company it is yet to be heard from. In brief, the company may engage in any business, in any part of the world, the only limitations imposed are that the capital must not exceed $250,000,000. The State is to receive an annual franchise tax of 1-100th of 1 per cent on a market valuation of the capital stock actually issued and 1 per cent on all shares owned in Connecticut. The men whose names are mentioned in the charter as incorporators are E. F. Harding, R. S. Masterson, C. B. Wilson, D. B. Giddings, and W. S. Downs, of Bridgeport, where the principal office of the concern will be located.

AMERICAN TELEPHONE.—An official of the American Telephone & Telegraph Company says: "The shares of the American Telephone Company will, without doubt, be traded in on the New York Stock Exchange within the next two weeks; to be more exact, probably Sept. 3. The listing commitee of the New York Exchange late in June recommended the listing of $15,000,000 4 per cent collateral bonds of 1929, and $94,237,500 capital stock, but the stock has not been traded in owing to delays in the engraving of new securities made necessary for trading on the New York board. The listing committee also recommended the listing from time to time of $20,709,000 additional stock."

SWARTS METAL COMPANY.—Creditors of the Swarts Metal Refining Company, which was recently declared an involuntary bankrupt upon the representations of Eastern dealers that it had sold for less than cost price $100,000 of raw material bought upon long time, have found that there are practically no tangible assets and that they will be heavy losers on account of the alleged unbusiness-like dealings of the company. The tangible assets were sold last week by the Referee in Bankruptcy for $4,050. The intangible assets amount to $20,000, while the claims of creditors amount to $130,000. Most of the creditors are New York and Eastern business houses.

SCHENECTADY RAILWAY BONDS.—The Schenectady Railway Company, controlling the entire railway and electric lighting business in the city of Schenectady, all of whose stock is owned by the General Electric Company, has built a double track extension to Albany, and has in course of construction a line to Troy. Other extensions are also in contemplation, which, with those mentioned, will make a property of considerable magnitude. Funds for the extensions are to be provided by an issue of $1,250,000 first mortgage bonds, which have been sold to N. W. Harris & Co.

WESTERN UNION.—A director of the Western Union Telegraph Company says that the earnings are continuing to show decided increases, although the full measure of business that obtained previous to the declaration of the steel strike is not being handled. Immediately before the steel strike the increase in the weekly earnings ran as high as $46,000, but the recent showing has been about $28,000 to $30,000 a week increase over the corresponding weeks of last year. The firmness of Western Union stock has been due to purchases by insiders.

DIVIDENDS.—The Chicago Telephone Company has declared the regular quarterly dividend of 3 per cent, payable Oct. 9. The Safety Car Heating & Lighting Company will, on Sept. 1, distribute

a 10 per cent stock dividend, and on Oct. 1 pay a cash dividend of 5 per cent., comprising a 2 per cent quarterly payment and an extra payment of 3 per cent. The stock dividend will be paid out of treasury stock. The directors of the Kings County Electric Light & Power Company has declared the regular quarterly dividend of 1½ per cent, payable Sept. 1.

TELEPHONE SECURITIES.—G. H. Ginther & Co., investment securities brokers, with offices in New York and Pittsburg, have opened offices in the Electric Building, Cleveland, Ohio. The firm makes a specialty of telephone bonds, and naturally turned to Cleveland as a center of the independent movement. The company will handle an issue of $600,000 in bonds, which will be placed on the market by the Consolidated Telephone Company and the Inter-Ocean Telephone & Telegraph Company, of Cleveland.

TELEPHONE MORTGAGE.—A $5,000,000 mortgage has been filed by the Illinois Telephone & Telegraph Company in favor of the Equitable Trust Company, as trustee. The money is to be used to complete the company's telephone system in Chicago and $3,000,000 has been obtained on the bond issue. The company will use the Strowger automatic system.

CHICAGO TELEPHONE.—Stockholders of record Sept. 26 will have the privilege of buying on Oct. 9 at par pro rata to their present holdings of stock $1,000,000 of the new stock to be issued by the Chicago (Bell) Telephone Company.

MEXICAN TELEPHONE.—The Mexican Telephone Company reports an increase of 15 per cent in earnings for the month of June and of 16 per cent since March 1.

Commercial Intelligence.

THE WEEK IN TRADE.—The reports from trade centers indicate that trade during the week tended toward enlargement, at steady and higher prices. Crop improvement, particularly in the Central West and Mississippi Valley, has been the mainspring of the more cheerful tone of advices and enlarged fall trade operations at such cities as Chicago, St. Louis and Kansas City. From the South better advices come, and at the great Eastern centers distribution is as good, at least, if not better, in volume than a year ago. Iron and steel show little change, accessions to the strikers in the case of the leading tube works of the country having been balanced by the reopening of "struck" mills in the Pittsburg district. Chicago iron and steel jobbers are reported besieged by buyers, and some Western consumers may have to shut down if supplies are not shortly forthcoming. It is interesting to note in this connection that the rail mills and concerns producing structural material have as yet not been affected by the strike. Building material is quite active, although the steel strike interferes with progress at some centers. The strike is, of course, the chief disturbing feature in the situation in the iron and steel trades. Net railway earnings for the half year are very encouraging. Reports by 126 systems, according to *Bradstreet's*, show an aggregate of $623,853,560 in gross, and of $195,629,942 in net, gains of, respectively, 10.5 and 14.9 over a year ago. Despite the damage to the spring wheat crop a year ago, the granger roads gained 7.4 per cent in net, while the coal roads lead the list of gains with 29.2 per cent; the Southwestern roads gained 26.4 per cent. In the metal market copper displayed greater activity, and large transactions took place in the home market both for early and distant deliveries. The export demand has also improved, but prices do not show any change. The following are the quotations: Lake copper, 16½ cents; electrolytic in cakes, bars or ingots, 16¼ cents; cathodes, 16 cents, and casting copper, 15⅞ cents. The failures for the week, as reported by *Bradstreet's*, aggregated 162 as against 178 the week previous, and 135 the same week last year.

BIG COPPER DEALS.—Arrangements are said to be under way for the incorporation of a new copper company with a proposed capital of $50,000,000. It is asserted that the contemplated corporation is designed to take over some seven or eight mines, including a number of the Clark properties. Amalgamated Copper interests decline to discuss a report that this concern has to do with the rumored impending copper combination for the entire United States. The prospective company is probably intended to play a part in the planned copper trust, which, it is thought, may embrace the Amalgamated, Anaconda, Calumet and Hecla, Rothschild, Lewisohn, and minor interests. The *Daily Chronicle* has obtained from Lord Rothschild a denial of any connection with or knowledge of the reported American copper trust. "My firm has no copper mines," he is represented as having said, "and I never heard before of Senator Clark." On the London Metal Exchange the report that the Rio Tinto would enter such a trust was discredited. The General Electric people are alleged to be spending considerable time and money endeavoring to get a suitable copper property; in fact, they have had experts looking over the field for many months. The company purchases between 30,000,000 and 40,000,000 lbs. of copper a year at a cost of between $5,000,000 and $6,000,000. If a good property could be secured which would be capable of development into a mine producing, say, 1,000,000 lbs. of copper per month, it would be a profitable investment for the General Electric Company.

CONSOLIDATION IN SOUTHERN CALIFORNIA.—It is reported that a combination of electric power concerns has been effected in Southern California by W. S. Tevis, president of the Kern Land Company, and Henry Fisher, of Redlands. The consolidated corporation, which aims to control all the water-power electric systems of the lower part of the State, will be known as the Southern California Power Company. It is said that contracts have been closed for the transmission of 15,000 horse-power to Los Angeles, delivery to be made through the Edison Electric Company, which has been consolidated with the Power Development Company and the original Southern California Power Company. Work has been commenced on the project of greatly increasing the output of the Bakersfield water power. New tunnels will be bored and hydraulic work done to provide for utilizing 5000 inches of water just above the Power Development Company's present electric plant, and thus the same water will be used twice. The new electric power plant to be installed in the Kern River Cañon will transmit current to Los Angeles via the old S. P. R. R. right of way, and its estimated cost is $2,000,000. It will be possible along this route to supply electric power to all the pumping plants in the Antelope Valley, the Kern River oil fields, Newhall oil fields and the towns in the San Fernando Valley. The San Gabriel Valley can easily be covered via Redlands.

DOMESTIC ORDERS FOR MOTOR TRUCKS, ETC.—The Peckham Manufacturing Company, whose New York offices are located in the Havemeyer Building, 26 Cortlandt Street, reports receipt of a number of contracts calling for trucks of heavy, high-speed types for utilization by Western interurban electric traction systems. Sixty trucks of this description have been recently ordered on behalf of the Chicago, Aurora & Elgin Railway, while seven pairs have been requisitioned for by the Columbus & Newark Traction Company. Other orders secured within the last week or two comprise 60 swing bolster maximum traction trucks for the Metropolitan system, Washington, D. C., and 40 pairs of short-wheel base swing bolster trucks for the North Jersey Railway. The Peckham Company also reports having received numerous inquiries for the Ruggles rotary snow plow, several of which have already been ordered for late fall delivery. Among the contracts lately obtained figure those from the Camden (N. J.) & Suburban Railway; Lehigh Valley Traction Company, Allentown, Pa., and the Somerset Traction Company, Skowhegan, Me.

SALES OF C & C MOTORS.—The Chicago office of the C & C Electric Company has just sent in orders for some seven or eight motors to go to St. Louis, Chicago and Milwaukee, besides an order for 11 motors in sizes ranging from 2 to 35 horse-power for the William J. Moxley Company, of Chicago. The Locomobile Company, of Bridgeport, Conn., has placed an order for a 60-hp motor. The company reports a number of recent orders for generating sets, and a decided improvement in the sale of motors for use on the Edison circuits in New York.

ELECTRICAL MACHINERY FOR JAPAN.—The American electrical engineering and contracting firm of Bagnall & Hilles, of Yokohama, is about to make shipment, by the General Electric Company, of some 125 tons of various equipment, which is intended to be used by one of the Japanese street railways now under construction. The Bagnall & Hilles people are reported to have secured another substantial contract for the equipment of a new electric traction system in that part of the world.

BALL ENGINE ORDERS.—The Yorkville Independent Hygeia Ice Company, New York City, has recently purchased an engine from the Ball Engine Company, Erie, Pa., for electric lighting. The National Carbon Company, Cleveland, Ohio, has purchased for electric light and power purposes, a 350-hp engine direct connected to a General Electric generator. The Ball Engine Company will furnish the engine.

MONTREAL SUB-STATION CONTRACT.—The contract for the construction of a new sub-station for the Royal Electric Company, of Montreal, Que., has been awarded to Messrs. P. Lyall & Sons, of that city, for all trades. The building will be fire-proof, and will cost about $100,000.

PLANT FOR MALDEN, MASS.—Mr. F. P. Royce, treasurer of the Malden, Mass., Electric Company, informs us that they are adding another direct-connected set of 500 kilowatts, making the third such set installed. They are also adding a cooling tower, induced draft system, and new buildings.

MACHINE TOOLS.—A $40,000 order for machine tools has been given to the Niles-Bement-Pond Company, by the Westinghouse plant in Manchester, England.

General News.

THE TELEPHONE.

GREENWOOD, ARK.—Mr. Jim McConnell is putting in a telephone system at Greenwood.

OZARK, ARK.—The Home Telephone Company, of Ozark, organized and elected the following officers: W. M. Quaile, president; L. R. A. Wallace, vice-president; G. W. Russell, treasurer; Tom Carter, secretary, and J. R. Davidson, J. C. Carter and M. B. Conaster, directors.

WASHINGTON, D. C.—In a series of suits instituted by the Chesapeake & Potomac Telephone Company against subscribers whose telephones had been withdrawn by the company for non-payment of bills rendered and the collection of which claims would soon have been barred by the statute of limitations, Justice J. Barton Miller gave judgment for the plaintiff. The Congressional rate was allowed in all cases where claims were proved. The statute governing cost of service was set up as defence.

CARTERSVILLE, GA.—The Southern Bell Telephone Company is preparing to establish a telephone system here.

ROME, GA.—The Bell Telephone Company is replacing its old instruments with new, and making other improvements to its system.

GAINESVILLE, GA.—Dr. Hardeman, of Harmony Grave, is erecting telephone lines from Jefferson to Gainesville along the Gainesville, Jefferson & Southern Railroad, and the road will use telephones.

WASHINGTON, GA.—The local telephone system will be connected with the long-distance system extending over Georgia and reaching outside the State. The local system is owned by T. W. Fitzpatrick and brother.

GAINESVILLE, GA.—J. M. Oliver is making rapid headway with his Mountain telephone system, that will connect Gainesville with nearly all the small towns and villages in the mountain counties above here.

CHICAGO, ILL.—The Eureka Telephone & Construction Company, Chicago, capital $50,000, has been incorporated by H. R. Platt, J. H. Rollins, and Sydney Stein.

EL PASO, ILL.—The El Paso Telephone Company has been incorporated; capital stock, $5,000. Incorporators: A. E. Fleming, J. L. Boner and R. E. Gordon.

PEKIN, ILL.—A Chicago firm was awarded the contract for the construction of the Citizens' telephone system, an independent company at Pekin, the bid being $26,600.

SPRINGFIELD, ILL.—The Humboldt Telephone Company, Humboldt, has been incorporated; capital, $2,500. Incorporators: James McDougle, S. C. Ashbrook, E. M. Mulliken.

ALTON, ILL.—The Kinloch Telephone Company has set its poles from the eastern limits of the city to the main business district, and work of stringing wires is now in progress.

SPRINGFIELD, ILL.—An independent telephone company which has been operating in Pekin, Lincoln and neighboring cities is endeavoring to secure a franchise in this city. A few years ago a local company was organized for the same purpose, but it allowed its franchise to lapse, and the effort died out.

EDWARDSVILLE, ILL.—At the conference between representatives of the Kinloch Telephone Company, of St. Louis, and the city authorities, nearly all the differences existing between the parties in interest relative to the granting of a franchise to the company permitting it to construct and operate a telephone exchange in this city were amicably settled, and it is now stated that an ordinance granting such franchise will be passed at the September meeting of the Council.

VALPARAISO, IND.—The Northwestern Indiana Telephone Company is building a new line from Hebron to Valparaiso.

WASHINGTON, IND.—The Central Union Telephone Company will in a few weeks commence the construction of a telephone line from this city to Odon and Elnora.

LYNN, IND.—The Lynn local telephone company, which was recently incorporated has been organized, and is now beginning business. It is using Stromberg-Carlson apparatus. The officers of the company are: S. C. Bowen, president; Daniel Hecker, treasurer, and W. E. Henshaw, secretary.

FRANKLIN, IND.—There is a strong prospect of a war between the local and Bell telephone companies at this place. The Bell Company says an exchange will be established here, and will cut the price of the local company. Public sentiment seems to be against the Bell Company, and its methods. The company has a long-time franchise, but has contented itself with operating a single pay station. The local company is affiliated with the New Company, of Indianapolis, and will make a strong fight to protect its territory.

WHITELAND, IND.—A few months ago the Town Board granted the Striekler local telephone company a franchise to use certain streets and alleys, and maintain a local telephone exchange here. The public station was opened and a switch was put in, but for some cause the local subscribers were not supplied with telephones. On August 17 the Central Union Telephone Company preempted the territory by swooping down on the town with a crowd of solicitors on a gorgeous tallyho, drawn by four gayly bedecked horses. A heavy wagon also entered the city unannounced, laden with tools and men and telephones, together with a complete switchboard. The company had not asked the town for a franchise, and as fast as the Central Union employes dug the post holes the town marshal and employes filled them up. Finally, the town marshal was called off, the town board deciding on another line of action. The Central Union erected several poles inside the corporation, but the trouble is not yet officially settled.

INDIANAPOLIS, IND.—S. P. Sheerin, vice-president of the New Telephone Company, says that his company will not cut its rates to meet the party line cuts announced by the Central Union. "We made our cut at the very beginning," he said, "and are supplying telephone service now for nearly 50 per cent less than the same class of service was at that time being furnished by the Central Union. We fixed our rates at a point where we felt sure of a fair profit, and have no intention of running our business at a loss. We do not believe the fair-minded people expect us to furnish them service of any kind at a loss to our company. We do not believe that the people of this city desire a cheap, inefficient, party-line service. The evidence that comes to us points very strongly the other way. It is our duty to give the people what they want. With our fingers at the public pulse all the time, we are satisfied that they want no such service as party-line service. Our demand for single-line service is greater than we are able to meet, and our only embarrassment comes from the difficulty in getting material to make extensions as quickly as they are needed. We have just completed plans which will increase our capacity to 7000 telephones."

INDIANAPOLIS, IND.—The Tax Board was kept unusually busy during the past week listening to the protests against assessments made against telephone companies. The Home Telephone Company, of Richmond, was the first heard. Perry J. Freeman, president of the company, contended that by comparison with telephone properties in Anderson, Elkhart and elsewhere, its plant had been assessed too high. R. E. Niven, a Thorntown banker, and president of the Thorntown Telephone Company, which was assessed last year at $1,000, and this year at $1,500, insisted that the increased assessment was a grievous error. He asserted that his company's income has been less this year than last, while its expenses have been increased. He said the company is seriously handicapped by a co-operative telephone company, formed by a number of farmers in the county, and that the latter company fights the Thorntown Company "tooth and nail," because the city company is owned by business men. C. M. Zion, representing the Lebanon Telephone Company, drew a picture of distress that was almost identical with that painted by Mr. Niven, including bitter competition with a farmers' co-operative telephone company. The Otterbein and Monon telephone companies sent a written protest in which the claim of poor profits and cheap construction was made. It asks to be let down with one-half of the proposed assessment. S. P. Sheerin, speaking for the New Telephone Company, of Indianapolis, argued that the assessment of his companies—the New and the New Long-Distance Telephone companies—ought not to be more than $20,000 in view of the bitter competition they have and of the expensive improvements which they must frequently install. A. G. Lupton, of Hartford City, made a plea for a reduction for the Indiana Telephone Company, of Hartford City, and its lately acquired property, the Marion Telephone Company. He said the Marion plant was in poor physical condition, and will have to be practically replaced by a new one at a considerable expense. He said the net earnings of the companies were comparatively insignificant. C. E. Mills, speaking for the Jasper County Telephone Company, said that the company had made errors in making out its tax return, which if corrected the companies' net income would be materially lessened, and asked that the board take in consideration that much of the line was made up of barbed wire fence, therefore, the assessment ought to be reduced. The Prairie Telephone Company, of Brookston, was represented by its secretary, J. L. Boardman, who said that this property was acquired from the Jasper County Long-Distance Telephone Company, and it ought not to be assessed higher than it was last year. He said no profits had accrued during the year. The Board fixed the assessment at $8,100, and Mr. Boardman said the figure ought to be reduced to $4,500. Other companies will plead.

GRUNDY CENTER, IA.—The Grundy County Telephone Company has been organized here. Contracts have been placed for the construction of an exchange in this city and the line will eventually be extended throughout the county. The authorized capital stock of the company is $10,000. The officers are: President, F. J. Frost; Treasurer, R. M. Finlayson; Secretary, F. W. Reisinger.

CHICAGO, ILL.—The Illinois Manufacturers' Association has decided to begin legal proceedings against the Chicago Telephone Company, which charges $175 a year for a business telephone, to compel it to refund the difference between that sum and $128, the limit fixed by its charter granted in 1889.

NEW ORLEANS, LA.—The Cumberland Telephone & Telegraph Company has been summoned to show cause why it should not be fined for violating the rules of the Commission by increasing the rate for a three minute conversation between Homer and Shreveport. This company has also been summoned to show cause why its rates in Shreveport should not be reduced on account of the extremely poor service which is being rendered there.

BALTIMORE, MD.—The Delmarvia Telephone Company and the Maryland Telephone Company are having a line built from Wilmington to Elkton, and from Elkton to North East, thence to Perryville, where connections will be made with a line which runs into Baltimore.

ALMA, MICH.—The Union Telephone Company has increased its capital stock from $150,000 to $200,000.

BAY CITY, MICH.—The Valley Telephone Company is installing a new switchboard in its exchange in this city.

SAGINAW, MICH.—The Valley Telephone Company, of Saginaw and Bay City, has completed its lines to Sebewaing. Many farmers along the route have put telephones into their residences.

JACKSON, MICH.—Articles of incorporation of the People's Telephone Company have been prepared, and are nearly ready for filing. The capital stock is fixed at $200,000. At a meeting of the stockholders the first board of directors was chosen, as follows: J. C. Richardson, Z. C. Eldred, G. W. Carter, G. A. Matthews, W. H. Maloney, M. F. Cottrell and Thos. M. Smith, of Jackson, and Arthur Pack, of Orchard Lake, and Joseph B. Ware, of Detroit.

MINNEAPOLIS, MINN.—The city hospital has just been equipped with a complete intercommunicating telephone system, connected with the Twin City Telephone Company's exchange. The switchboard at the hospital is similar to the one recently installed at the Courthouse.

MINNEAPOLIS, MINN.—The Twin City Telephone Company is preparing a novel and useful exhibit at the State fair, and at the same time will institute telephonic connections with both cities. A switchboard of the latest style lamp-signal board has been placed in the manufacturers' building, and with it will be

a complete exhibit of all instruments necessary in telephone construction. More than twelve miles of wire are being stretched on the grounds, and about thirty telephones will be placed in the various buildings. A toll of 5 cents will be charged to telephone to either city.

WINONA, MINN.—The Winona Telephone Company is just completing extensions and improvements that have been made this summer at an expense of close to $2,500, increasing the number of telephones having direct connection with the Winona exchange to close to a thousand. Twenty-five farms between Altura and Minneiska have been given telephone connection, and a line is now being finished from Witoka to Pickwick and La Moille that will add as many more farms to the exchange. The Winona company was the fourth independent company to be established in the United States, and has grown steadily from the start.

JACKSON, MISS.—The Mississippi Telephone Company, Laurel, Miss., has been incorporated, with a capital of $30,000. The incorporators are W. C. Welborn, E. D. Pierce, J. W. Watt and N. P. Welborn. The company has authority to build and operate lines between New Orleans and Meridian, Mobile and Jackson, Laurel and Kingston, and most any other place it may desire.

HELENA, MONT.—It is said that an agreement has been reached between the Rocky Mountain Telephone Company and the Northwestern Company by which the former will build at once from its present eastern terminus at Billings to Miles City, Mont., while the Northwestern Company will build west from its North Dakota terminus to Miles City.

HENDERSON, N. C.—The Henderson and Carolina & Virginia telephone companies have now under construction a double metallic circuit from Henderson via Rocky Mountain, Goldsboro, Kinston, New Berne and intermediate points to Morehead and Beaufort. One circuit is of iron for local business, and one of copper for through service. The completion of this line about October 15 will connect all the principal East Carolina cities with the rest of the State and give these companies over 1200 miles of metallic toll line in Carolina and Virginia. Exchanges will be built at Morehead and Beaufort, which are important fish, oyster and lumber points, and the former one of the finest summer resorts on the south Atlantic coast. The Henderson Telephone Company is now installing at New Berne a 450 metallic Couch & Seely board equipped with an improved lamp transfer system, the invention of Mr. F. C. Toepleman, general superintendent of the companies.

RALEIGH, N. C.—Judge W. S. O'B. Robinson has granted a temporary restraining order to the American Electric Telephone Company to show cause why the Raleigh Telephone Company should not be placed in the hands of a receiver. The application for a receiver will be determined August 29. The local company claims that this action is unwarranted, and that it is perfectly solvent. The plaintiff alleges that the incorporation of the company was not legal, and that it has failed to comply with the provisions of the articles of agreement, etc.; also plaintiff claims $3,500 due by note given December 22, 1900, and due in 60 days; also plaintiff alleges that it is informed of other debts of this company.

TRENTON, N. J.—The Delaware & Atlantic Telephone Company, has reduced the rate for local calls from ten to five cents. Cuts have also been made in the long distance service, it being the intention of the company to charge, in the future, about one-third less for out-of-town calls than has been demanded in the past.

JAMESTOWN, N. Y.—The Home Telephone Company, of Jamestown, has secured 400 contracts out of 500 desired.

NEW YORK, N. Y.—The New York & New Jersey Telephone Company has just placed in operation a scheme which will prove of great service to passengers on the transatlantic liners that sail from Hoboken. On the steamships Deutschland and Columbia the company has placed "nickel in the slot" telephone instruments, which are connected with the shore by a wire attached to the ship as she lies in her pier. The wire remains connected up to the last moment of sailing. When the ship moves out the cord is disconnected. Likewise when either of the ships arrives the telephone cord is the first thing to be connected.

FT. RECOVERY, OHIO.—The Ft. Recovery Telephone Company has been incorporated.

HILLSBORO, OHIO.—The New Home Telephone Company of this place has begun stringing wires here.

HUBBARD, OHIO.—The Youngstown Telephone Company has been granted a franchise to install an independent telephone exchange in this place.

PAINESVILLE, OHIO.—The Painesville Telephone Company has increased its capital stock from $20,000 to $75,000 to provide for improvements.

BELLEFONTAINE, OHIO.—The Bellefontaine Telephone Company has secured the franchise for an independent telephone line through Zanesfield.

CINCINNATI, OHIO.—An independent telephone syndicate is making efforts to get a foothold in this city. It is understood that the company now has a fair show of success.

CINCINNATI, OHIO.—About 500 employes of the Cincinnati Telephone Company enjoyed their annual outing a few days ago, the Mutual Benefit Association organization of employes defraying all expenses.

FREMONT, OHIO.—J. P. McGahan, for several years manager of the Central Union Telephone Company's (Bell) exchange at this point has been appointed assistant superintendent of the properties in Ohio.

CINCINNATI, OHIO.—The City & Suburban Telegraph Association, of Cincinnati, will establish a complete exchange at the Cincinnati Fall Festival, which opens September 16. The workings of the modern telephone exchange will be shown in all its completeness.

CALDWELL, OHIO.—The Woodsfield Telephone Company has organized by electing J. B. Rhodes, of Zanesville, president; L. E. Stegner, Lewisville, vice-president; J. S. Cawley, Woodsfield, secretary and treasurer. The board of directors is composed of the above-named gentlemen and E. A. Culbertson, of Coreapolis, Pa.

TOLEDO, OHIO.—Manager Frank Graves, of the Toledo Home Telephone Company, denies that the Everett-Moore syndicate has any financial interest in his company, and claims that the organization is controlled by Toledo people. He says, however, that the company will work in harmony with the Everett-Moore system of long-distance lines.

PORT CLINTON, OHIO.—The successful stringing of the telephone cable from Put-in Bay three miles across to the Catawba Island mainland has been tested, and is now in service. The cable was laid by the Port Clinton Home Telephone Company at a cost of $10,000. Connection from Put-in Bay to Middle Bass by cable is also being made, and exchanges will be established here and at Put-in Bay.

HOPEDALE, OHIO.—The Home Telephone Company, of this place, has been organized by the following persons: W. H. Copeland, John B. Beadle, Asbury Cole, Martin Snyder, J. M. Copeland, J. G. Dixon, J. P. Ligett, Jacob Copeland, I. M. Irwin, J. R. Skelley, J. M. Kile, William Holmes, Winfield Holmes, W. V. Scott, J. B. Francis and N. B. Buckingham. They will build lines in Hopedale, Miller station and Greenough, with a farmers' system through out the community.

TORONTO, ONT.—Mr. Wayling, of Buffalo, N. Y., one of the company which offers to establish an independent telephone system in the city of Toronto, Ont., says that after the holiday season closes negotiations will be resumed with the Toronto City Council if the latter shows any desire to talk business. Mr. Wayling said: "As a guarantee of good faith we offered to put up a bond of $50,000 as security that we would install a plant and fulfil our contract to the letter. If we get a franchise, we will give Toronto a thoroughly up-to-date system at a cost of about $1,200,000. Every instrument would be on a metallic circuit of its own. Our rates would be $36 for a business telephone, or $50 for both a business and a residence telephone on one circuit. If two house subscribers choose to go on one line, a rate of $18 or $20 each would be allowed. It is for the civic authorities to decide whether they want relief from the present situation or not."

PORTLAND, ORE.—Napoleon Davis and John Lamont, president and vice-president, respectively, of the Columbia Telephone Company, have disposed of their interest to a syndicate of capitalists from Ohio and will retire from the company. All parties to the deal decline to give the purchasing price. The new owners of the system are the same men that are putting in an independent telephone system in Seattle. The intention is to unite the two systems, and establish long-distance connection between Portland and Puget Sound points. Eventually, it is said, the system will be extended so as to include all points of importance in Washington and Oregon, but for the present the connection will be between Seattle and Puget Sound. In addition it is proposed to improve the Columbia Telephone system in Portland, and an effort will be made to extend the service throughout the city.

MANSFIELD, PA.—The Citizens' Mutual Telephone & Telegraph Company, of Mansfield, capital $1,000, has been incorporated.

PITTSTON, PA.—A movement is on foot for consolidation of the Central Pennsylvania and People's Telephone lines. The People's Company is a young concern, with lines extending from Hazleton to Carbondale.

PITTSBURG, PA.—About 100 linemen of the Federal Telephone Company organized in the International Brotherhood of Electrical Workers have gone on a strike in this city upon a refusal on the part of the management of the company to sign a new scale of wages. The scale provides for a rate of $2.50 for a nine-hour day, with extra pay for overtime, Sundays and holidays, and a day's wages for men reporting for work on inclement days. This last feature was a material feature in causing a failure to arrange an agreement with the company.

SPARTANSBURG, S. C.—The Bell Telephone Company has secured the franchise from the City Council at Union, and will build an exchange.

CANTON, S. D.—The work of connecting Mitchell and Woonsocket by telephone is expected to be completed about Sept. 1.

ERIN, TENN.—The Hamilton County Telephone Company has just completed a telephone exchange at Stewart Station, Tenn.

DAYTON, TENN.—J. H. Hood, local manager of the Cumberland Telephone Company's exchange, states that the company will at an early date complete its lines from Chattanooga via Dayton to Cincinnati.

TEXARKANA, TEX.—The East Side City Council has granted a Mr. Richardson and associates the right to maintain and operate a new telephone system in Texarkana, Ark.

GALVESTON, TEX.—President H. M. Aubrey, of the Commercial Telephone Company, with headquarters in San Antonio, has arranged the details for the entrance of his company into Galveston.

NEWPORT NEWS, VA.—It is stated that the Long-Distance Telephone Company, of Virginia, will complete the line connecting Newport News, Williamsburg and Richmond within 30 days.

GRAFTON, W. VA.—The People's Telephone Company has been reorganized at Grafton, W. Va., and will be known as the Taylor, Preston & Barbour Telephone Company. The line penetrates the counties named and will be put in first class order.

PARKERSBURG, W. VA.—A deal has been closed here whereby the lines owned by the West Virginia Telephone & Telegraph Company, formerly operated by the Bell Company, pass into the possession of A. C. Davis, G. A. Davis and R. H. Rutherford, all of them local capitalists and interested in the West Virginia and Western Telephone Company. The lines purchased extend from this city to Volcano and through a part of Ritchie County.

RACINE, WIS.—Four men were sentenced a few days ago to five months in jail for stealing 2000 lbs. of copper wire from the Wisconsin Telephone Company.

SPOKANE, WASH.—The Pacific States Telephone Company has absorbed its only rival in the Inland Empire, the Spokane & British Columbia Telephone & Telegraph Company. The $205,000 damage suit of Spokane & British Columbia Telephone & Telegraph Company against the Inland Telephone & Telegraph Company was settled out of court, and there is a rumor out to the effect that the former company has been absorbed by the latter.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Tuolumne River Mining & Power Company was recently incorporated, with Los Angeles, Calif., the principal place of business. Directors: L. M. Gregory, R. B. Dickinson, E. B. Landt, H. V. Cator and S. V. Landt. Capital stock, $200,000.

SAN FRANCISCO, CALIF.—The People's Gas & Electric Company has been incorporated, with San Francisco as the principal place of business. Directors: G. D. Clark, F. G. Breekman, F. J. Byington, B. F. Clark, W. M. Abbott, G. A. Stutevant and C. O. Gale. Capital stock, $3,000,000; subscribed, $700.

NORWALK, CONN.—The Heating & Lighting Corporation has been incorporated here.

ATLANTA, GA.—A. E. Thornton, J. L. Anderson and W. R. Power have filed application for an injunction against Joseph S. Sliver and others, asking that the defendants be restrained from building a dam six miles above Bolton across the Chattahoochee, alleging that the dam would change the course of the stream. This action is regarded as the opening fight between the two corporations formed to build power plants on the Chattahoochee. A temporary restraining order was granted and the case will be heard later.

INDIANAPOLIS, IND.—The American Light & Water Company has been incorporated here.

WINDFALL, IND.—The town trustees of Windfall have approved the estimate for an electric light plant and are now inviting bids for the construction of the plant.

BATESVILLE, IND.—The American Furniture Company, of this city, has completed and installed an electric plant at a cost of $25,000. The company will furnish light to the city and light and power to other manufacturing enterprises

INDIANAPOLIS, IND.—The Council has decided to refuse to ratify any contracts made by the city administration for electric lighting between now and the city election in October. The whole franchise question is sure to get into the campaign and the people generally are calling on the Council to stand firm, as no interests will suffer by the delay. The belief is general that there has been an attempt to favor one of the two prospective bidders. The court, having enjoined the letting under the original specifications, the amended specifications are equally objectionable on the ground of discrimination. Hence, the Council will hold the matter up, and if necessary another appeal to the court will be taken.

INDIANAPOLIS, IND.—The new specifications for the electric lighting contract for this city have been held up again on the ground of discriminating against the Indianapolis Light & Power Company, in that they require enclosed arc lamps, the latter company now using open arcs. The matter of merit was submitted to Professor Goldsborough, of Purdue University. For two years, he says, experiments have been conducted at Purdue University under his direction at a considerable outlay of time and expense on these two types of lamps, and the results obtained have been of the highest value to the electrical profession. The Professor concluded by advising the city to adopt the enclosed arc lamps with the amount of reserve power specified and install the most improved and modern machinery. If this is done the citizens would never have cause to complain of their illuminating facilities, and the city would be one of the best illuminated in the country.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company has submitted a proposition to sell its electric light and water works plant to the city for the sum of $140,000.

READING, MICH.—This town is to have an electric light plant of its own; the appropriation has been made, contracts have been signed, and all that now remains is for the contractors to perform their work.

MAUTON, MICH.—The municipal lighting plant here has at last been completed. While not so quickly as was at first anticipated, it is nevertheless now running, and the villagers are having a sort of a celebration in honor of the event.

GRAND RAPIDS, MICH.—The Michigan Soldiers' Home a short time ago closed a contract with the General Electric Company for a 60-kw, 125-volt generator, direct-connected to an Ideal engine, set ready to run, and including all instruments, wiring, etc. The Home is also making extensive alterations and additions to its power-house and pumping station.

GRAND RAPIDS, MICH.—The Masonic Home, located near the outskirts of the city, is now installing a system of storage batteries and motor-generator for lighting its building and running an electric hoist which was formerly operated by hydraulic power. The current for operating the motor-generator will be furnished by the Grand Rapids Railway Company.

GRAND ISLAND, NEB.—The City Electric Light & Ice Company has been incorporated, with a capital stock of $200,000.

AUBURN, NEB.—The Auburn Mutual Light & Power Company has been incorporated, with a capital stock of $30,000.

FREMONT, OHIO.—The water in the Sandusky River dropped to such a low point last week that the lighting plant was obliged to close down, leaving the city in darkness.

GENEVA, OHIO.—The Geneva Electric Lighting Company has been given a contract to light the village streets until the Everett-Moore syndicate completes its plant here, when it is to have the contract.

LIMA, OHIO.—Joseph Mayer, president of the Lima Electric Light & Street Railway Company, has secured a franchise to install a steam heating plant in this city, to be operated in connection with the lighting plant.

CLEVELAND, OHIO.—The County Commissioners have decided to readvertise for bids for the equipment of a lighting plant to furnish current to illuminate the various county buildings. George S. Rider is engineer for the city.

BOWLING GREEN, OHIO.—The Citizen's Electric Light & Power Company has been absorbed by a new company, to be known as the Bowling Green Light, Heat & Power Company. It is stated that the company will furnish power to two electric railways, besides illuminating the city.

BARBERTON, OHIO.—O. C. Barber, the millionaire match manufacturer, and founder of this town, has made a proposition to the village Council to build a $75,000 water works and electric light plant, if the Council will agree to drive wells on his property and give him the use of water mains in use. The proposition was accepted.

DOYLESTOWN, OHIO.—A number of citizens have secured an injunction restraining the Council from issuing bonds for the purpose of building a municipal lighting plant. At the time of the election to pass the issue of bonds, it was understood that the plant was to be furnished as a bonus to secure an electric railway, but the project has been abandoned and the majority of people are now averse to a municipal plant.

CINCINNATI, OHIO.—General Manager W. F. White, of the new combination of Cincinnati illuminating interests, the Cincinnati Gas & Electric Company, has been entertaining a dozen bidders on machinery, etc., to be taken out of the to be dismantled plants. Among these are included the plant of the Cincinnati Gaslight & Coke Company, the First Cincinnati Edison Company, the Brush Electric Company, and the Jones Bros. Electric Company, which latter will not be dismantled until the first of the year.

CLEVELAND, OHIO.—Evidence that the Everett-Moore syndicate proposes to engage in the electric lighting business in points touched by its traction lines is shown by several recent developments. The recent purchase of the system of the Toledo Traction Company included a large lighting plant, and through a consolidation last week of the Sandusky city lines with the interurban roads radiating from that point, the syndicate secured control of the plant of the Sandusky Gas & Electric Company. At Geneva, Ohio, Fred. Storm, a prominent member of the syndicate, has secured a contract to furnish light to the city, and it is announced that the plant will be operated in connection with the plant for the extension of one of the traction lines to Geneva and Ashtabula. This plant will be built at once. At Akron, Ohio, the Northern Ohio Traction Company, one of the syndicate properties, holds a contract to light the city, and the same is true at Barberton. It is reported at Massillon that the syndicate has secured an option on the plant of the Massillon Light, Heat & Power Company. The syndicate is building a branch line to Massillon.

HAMILTON, ONT.—The Napanee Electric Light Company has absorbed the John R. Scott Company, which controlled the lighting along the Napanee River.

KINGSTON, ONT.—The arbitration proceedings to determine the value of the electric light and gas plants in this city, is progressing slowly. The expenses are stated to be $600 per day. The company says that its electric plant is worth $97,000, and it has a guaranteed offer of $120,000 for it and its franchise. The arbitration will last for some time.

OTTAWA, ONT.—The work of setting the plant for the lighting of Lachine Canal by electricity has been commenced, and will, it is expected, be completed in time for next season's business. The Canadian Electric Company has been given the contract for building the machinery, and Messrs. Ahearn & Soper, of Ottawa, have the contract for the poles and wires. The Government is building a power-house at St. Paul, and with the completion of the entire work, the canal will be lighted, for the first time, by electricity entirely.

OTTAWA, ONT.—The new No. 2 power-house of the Ottawa Electric Company is constructed of concrete, brick and iron. It will be equipped with Westinghouse alternating-current generators, rotary converters and induction motors, also arc machines, of the Western Electric Company's make. The units will consist of three 700-kw machines direct-connected to water-wheels, and two 700-kw belted to water-wheels; the arc machines will be of 150 lights capacity, direct-connected in pairs to induction motors. There will be six of the latter units. The plant will also contain 250 cells of chloride accumulators, and Westinghouse boosters. There will also be a Wheeler tandem-compound condensing engine of 1000-hp.

LANCASTER, PA.—The Lancaster County Railway & Light Company has awarded contracts for a power plant, to cost $500,000. The company will furnish power to all the electric car companies and electric lights to all the villages and boroughs in the county.

WHARTON, TEX.—A franchise has just been granted by the Commissioners of Wharton County for the establishment of a big electric plant at El Campo and the right to string wires along the public highways. The scheme is to supply power to the pumps which are used to flood the rice fields in this section, and which are now costly to operate by the single traction engine process. The projectors of the enterprise are also interested in the rice business, and own a big canal. They believe that the demand for the power will be so great that there will be a profit after they have paid the expenses of the plant and of operating their own machinery.

RICHMOND, VA.—The Virginia Electrical Railway & Development Company will greatly enlarge its plant on James River. When the contemplated improvements are made, the capacity will be 12,000 horse-power. Something like $200,000 will be spent in the proposed improvements. Plans are now being prepared. The power-house will be enlarged and room made for more machinery for the conversion of the river's power into electrical power.

EVANSVILLE, WIS.—The Evansville Water, Light & Power Company has been incorporated, with an authorized capital stock of $10,000.

LA CROSSE, WIS.—The new consolidated lighting company has asked for a 25-year extension of its franchise. The present franchise of the company expires in 1907.

MILWAUKEE, WIS.—The Wisconsin Bridge & Iron Company is enlarging its electric power plant. A new switchboard and an additional 50-kw generator and also 20 motors will be installed.

LA CROSSE, WIS.—An entire block in the business part of this city will be lighted electrically. The power is to be furnished by an isolated electric plant installed by the property owners in that block wishing electric lights. The rates charged by the new lighting company which bought out all the plants in the city are considered exorbitant, and for this reason the independent plant is to be built. It is probable that other plants will be established.

THE ELECTRIC RAILWAY.

BESSEMER, ALA.—The city has granted a franchise to the Steel Cities Railway Company, R. F. Hanneman representing the company. The company proposes to connect Ensley, Ala., and Bessemer, a distance of about seven miles.

BIRMINGHAM, ALA.—The stockholders of the Birmingham Railway, Light & Power Company, in accordance with the recent deal consolidating the several properties, have increased the directorate by adding six members to the Board. The officers are: William Jemison, president; William A. Walker, vice-president; J. P. Ross, secretary and treasurer.

NEW HAVEN, CONN.—The incorporators of the Windsor Locks and Rainbow Street Railway Company, which was chartered at the recent session of the general assembly, have organized by electing the following officers and directors: President, Henry A. Huntington, Windsor; Secretary and Treasurer, Frank E. Healy, Windsor Locks.

DANBURY, CONN.—The promoters of the interstate trolley line being built between Danbury, Conn., and Golden's Bridge, N. Y., seventeen miles, state that the road will be opened for traffic not later than December 1. Delays from the excessive prices which owners put upon land desired for rights of way have been practically overcome, and the construction force is being largely increased. The company has issued $300,000 stock and $200,000 bonds, which has not all been disposed of.

EAST ST. LOUIS, ILL.—The proposed electric line from East St. Louis to Chester, passing through Millstadt, Columbia, Waterloo, the Mammoth Cave grounds, and Red Bud, is now a certainty. The St. Louis and Belleville Suburban Railway Company, which is the promoter, has a line to Collinsville and Edwardsville, and is building between O'Fallon and Lebanon, with the expectation of completing it in four months.

KANSAS CITY, MO.—A syndicate of Boston people are considering a project to build a high-speed electric road between Kansas City and St. Joseph, Mo., a distance of fifty-three miles. Such a project would require the building of a bridge across the Missouri River at a cost of about $1,000,000, and the plan involves an expenditure of between $2,500,000 and $3,000,000. At the present time these cities are connected by two roads, the Burlington and Chicago Great Western, but the distance by steam road is sixty-two miles. If the electric road as contemplated is built the time between the two cities would be cut down, and fares cut in half. The road would do a freight as well as a passenger business.

WATERVLIET, N. Y.—The Common Council of Watervliet has dealt the United Traction Company a blow by refusing the application of the corporation for new franchise privileges.

ALBANY, N. Y.—A suit has been begun by the United Traction Company to recover damages from the City and County of Albany on account of the destruction of cars and other property during the strike. The suit is based upon the alleged failure of the authorities to afford the company ample protection.

LOCKPORT, N. Y.—At a recent meeting of the Elmwood Avenue & Tonawanda Electric Railway Company the following directors were elected: W. Caryl Ely, William B. Rankine, Burt Van Horn, Francis Lynde Stetson, T. Dewitt Cuyler, Robert Bacon, Daniel S. Lamont, E. G. S. Miller and Joseph B. Mayer.

WHITE PLAINS, N. Y.—The New York and Stamford Railway Company has formed at White Plains with a capital of $500,000 to build a through trolley line to Boston. The company represents the consolidation of the Larchmont and Port Chester electric companies, which now operate trolley systems from Larchmont to Port Chester. The new company is now building a road to Greenwich, and as soon as this line is completed the road will be extended to Stamford and afterward to Boston.

LIMA, OHIO.—The County Commissioners have granted the Defiance, Ottawa, Kenton & Columbus Interurban Railway the right of way through this county.

WARREN, OHIO.—Work has been started on the erection of the Mahoning Valley electric line from Warren to Leavittsburg. By October 1 electric cars will be available from Leavittsburg to New Castle, Pa.

TORONTO, ONT.—Plans and profiles for the Fort Erie Ferry Electric Railway have been submitted to the Minister of Public Works for approval at Toronto, Ont. The plans show an electric road running along the bank of the Niagara River, from Chippewa to Fort Erie, a distance of about twenty miles.

TOLEDO, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company has been incorporated, the capital stock being $100,000. The object of the company is stated to be an electric line between the cities named. Incorporators: Ellis Bartholomew, Wm. P. Hester, Wm. T. Stephens, Samuel Chester and Claude Wyant. The headquarters of the company are at Toledo.

UPPER SANDUSKY, OHIO.—The County Commissioners have granted Dr. O. C. Stutz, as trustee, the right of way to construct an electric interurban railway from this city to the county line beyond Sycamore. The road will run north to what is known as the Kilbourne road, one mile north of here; thence northeast through Belle Vernon to Sycamore, and from Sycamore to Melmore and Tiffin.

TORONTO, ONT.—The Toronto Railway Company contemplates making some extensions.

OTTAWA, ONT.—The Huron, Goderich & Middlesex Electric Railway Company, of Goderich, Ont., has been formed to construct an electric railway from Goderich to Wingham and Seaforth, Ont.

OTTAWA, ONT.—The electric street railway company, of Ottawa, proposes to elaborately decorate its lines in view of the royal visit at the capital next month, and all the cross wires on the principal streets will be hung with colored lanterns. The estimated cost of this work amounts to many thousands of dollars.

ELLWOOD CITY, PA.—The Ellwood Street Railway Company has been formed; capital, $9,000. President, A. W. K. Billings, Pittsburg.

MECHANICSBURG, PA.—The Star Street Railway Company has been formed. The line is three miles long, to Bowmansdale; capital, $18,000.

BLOOMSBURG, PA.—The Bloomsburg & Benton Street Railway Company has been incorporated; capital, $120,000. President, William S. Moyer.

QUAKERTOWN, PA.—The absorption of the Quakertown Traction Company by a company which is building a road southward from Bethlehem is practically completed. This new road to Quakertown will give a continuous line from Allentown to Philadelphia.

SCRANTON, PA.—The agreement has been signed by the city and the Coalville and the Wilkesbarre & Wyoming Traction Company by which the company in return for the franchises on a number of streets gives the city $15,000 in cash and agrees to do paving worth $35,000.

SOUTH BETHLEHEM, PA.—The South Bethlehem & Center Valley Street Railway Company, six miles long, has been formed to run from South Bethlehem to Soudersville, to Colesville, to Friedensville, to Center Valley and return; capital, $36,000. M. Hale Jones, of Easton, is president.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Railway Company, whose trolley lines are to connect McKeesport and Uniontown and most of the smaller towns between those points, is making preparations for the construction of about twenty-five miles more of track, on branches between the two main points.

YORK, PA.—The York & Dallastown Electric Railway has been opened. The road is seven miles long and is the first of a number of trolley lines that will be built from York by the York County Traction Company. William H. Lanius is president of the company. The company is also building a line from York to Dover, where it will connect with the Harrisburg and Mechanicsburg lines.

LANCASTER, PA.—The capital stock of the Lancaster & Mount Joy Electric Railway has been increased from $78,000 to $400,000, and arrangements have been made by the company for leasing its line to the Conestoga Traction Company for 999 years, at an annual rental equal to 6 per cent interest upon the actual cost of the road.

SEWICKLEY, PA.—The following new corporations have been filed: The Wampum & Hoytdale Street Railway Company; capital, $15,000; President, Richard R. Quay. Hoytdale & Beaver Falls Street Railway Company; capital, $30,000. Moravia & Wampum Street Railway Company; capital, $9,000. Wampum Street Railway Company; capital, $6,000. The officers of these three companies are the same as those of the Wampum & Hoytdale Company. New Castle & Moravia Street Railway Company; capital, $30,000; President, Richard R. Quay.

HARRISBURG, PA.—The following companies have been chartered here: The Beaver & New Brighton Electric Street Railway Company, to build a line five miles long; capital, $30,000. The Beaver Falls & New Brighton Electric Street Railway Company, to build a line four miles long; capital, $24,000. The Freedom & North Rochester Electric Street Railway Company, to run from Freedom, through Rochester and return, a distance of three miles; capital, $18,000. The Union Electric Street Railway Company, to build a line one mile long; capital, $6,000.

POTTSTOWN, PA.—The Ringing Rocks Traction Company has been granted a charter to connect with the Ringing Rocks line and Boyertown. It will run nine miles through a thickly-settled territory, and its route will touch New Berlinville, Morysville and Fagleysville. Three other companies, the Boyertown Electric Railway Company, the Boyertown & Limerick Company and the Pottstown & Sanatoga Company, were all after the same route. The company's capital stock is $54,000, and the officers are: President, Lynn Q. Guldin, of Reading; A. K. Shaner, Ralph E. Shaner and Dr. W. B. Shaner, of Pottstown; L. E. Lefever, of Boyertown, and Cyrus Q. Guldin.

PITTSBURG, PA.—The Councils of Allegheny City last week passed a number of ordinances granting street railroad franchises, which will bring an entirely new element into the street railway business of that city. The men at the head of this new system are the Mellons, powerful bankers of the city of Pittsburg, who also control the Monongahela Traction Company's lines, as well as the Monongahela Electric Light & Power Company. The franchises granted are for the City View Street Railway Company, the Allegheny Hilltop Street Railway Company, the Benton Avenue Street Railway Company, the Howard and East Street Railway Company, the Superior Avenue and Shady Avenue Street Railway Company and the East Street & Evergreen Street Railway Company.

QUAKERTOWN, PA.—The Quakertown Traction Company has just completed a survey for a 12-mile extension from Perkasie to Doylestown. This will give a continuous line from Quakertown to Philadelphia, a distance of about forty miles. The fare for this distance will be about 40 cents, against $1.52 by the Philadelphia & Reading Railroad. Three bridges will have to be erected on the new extension. The contracts for these have not yet been given out. The equipment and roadbed material have already been contracted for. The company will build a new power-house at Perkasie, and abandon the present temporary power-house in Quakertown. All of the equipment for the new plant has been ordered. Mr. W. H. Davies is treasurer and general manager of the company.

PITTSBURG, PA.—The following new corporations have been filed: The Sheridan Avenue Street Railway Company; capital, $6,000; President, Thomas S. Bigelow. The Atlantic & Neville Street Railway Company; capital, $6,000; Matilda & Dauphin Street Railway Company; capital, $12,000. The officers of these companies are the same as those of the Sheridan Avenue Street Railway Company. The Kentucky Avenue & Howe Street Railway Company; capital, $12,000; President, Thomas S. Bigelow. Bellefield Street Railway Company; capital, $3,000; President, Thomas S. Bigelow. Bellefield & Oakland Street Railway Company; capital, $9,000; President, Thomas S. Bigelow. Stanton Avenue Street Railway Company, Pittsburg; capital, $3,000; President, John Jenkins, Pittsburg. Beatty Street & Highland Park Street Railway Company; capital, $75,000; President, John Jenkins. The East End & Wilkinsburg Street Railway Company; capital, $12,000.

SAN ANTONIO, TEX.—The San Antonio Traction Company has commenced work on the West End line.

EL PASO, TEX.—The City Council has granted an amended franchise to the Goodrich Street Railway Company.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has placed an order for 150 tons of street car rails with the Pennsylvania Steel Company of Pittsburg. This is the first step in the improvements of the road since the issue of $350,000 in mortgage bonds for that purpose.

NASHVILLE, TENN.—The Hambleton syndicate has withdrawn from active control in the Nashville Railway Company and the Nashville Electric Light & Power Company. Percy Warner has been elected president of both companies. The Nashville railway was placed in the hands of a receiver some time ago, but all outstanding bonds were not represented in the litigation.

CHARLESTON, W. VA.—The Charleston & Kanawha Valley Power & Railway Company has been chartered; capital, $500,000. It is proposed to build an interurban electric railway to Montgomery and St. Albans. Howard T. Goodwin, John W. Coburn and C. M. Coburn, of Philadelphia; E. D. R. Sutton, of Wilmington, Del., and T. J. Carmack, of Charleston are the incorporators.

WHEELING, W. VA.—The contract for grading, masonry, trestling and furnishing timber for the construction of the new Panhandle Traction Company line has been awarded to Stringer & Hallock, of Wheeling, for $190,000. The contract for the rails was let to the Cambria Steel Company, Johnstown, Pa. This is the electric line between Wheeling and Wellsburg, and cars will run between the two points in about 45 minutes.

JANESVILLE, WIS.—Franchises are being asked for an electric railroad to run between Geneva Lake and Janesville, through Elkhorn and Delavan, a distance of thirty-four miles. Philadelphia capital is back of the deal.

MADISON, WIS.—Mr. P. L. Spooner is promoting an electric railway to connect Madison with Janesville, via Stoughton and Edgerton, a distance of about 40 miles. Mr. Spooner expressed himself as very sanguine of the building of the line.

MADISON, WIS.—Work has been begun on the erection by Philip L. Spooner of a $20,000 electric power-house to furnish power for the Madison street railway system, of which he is president, until the power from the Kilbourn dam is brought into service.

WEST SUPERIOR, WIS.—The Duluth-Superior Traction Company has had its franchise extended 12 years. The company's franchise is at present good for 18 years, but in order to make contemplated improvements in its present system an extension was desired.

GRAND RAPIDS, WIS.—That an electric line will shortly be constructed between this city and Stevens Point is now an assured fact, and this will be the beginning of a road which will traverse the whole length of the Wisconsin River Valley. The stretch which will be completed first is about thirty miles in length, and the water power of the valley will be utilized.

OSHKOSH, WIS.—The Winnebago Street Railway Company has been sold by Emerson McMillin & Company to F. S. Donnell and Boston associates. The deal was consummated August 12. The company is capitalized at $650,000, and owns about 25 miles of tracks, including a line from this city to Neenah. The distance between the terminals of the Fond du Lac electric line and the Oshkosh line is about 14 miles and a line covering this distance will probably be built.

THE AUTOMOBILE.

THE STUDEBAKER WAGON & CARRIAGE WORKS, of South Bend, Ind., has entered upon the manufacture of automobiles.

AUTOMOBILE RACES AT NEWPORT.—The announcement is made that the races of the National Automobile Racing Association at Newport will take place on the afternoon of Aug. 30, as follows: Once around the course for tricycles and two-wheeled vehicles for two prizes; once around the course for all classes of steam vehicles, two prizes; once around the course for electric racing machines, two prizes; once around the course for special class of De Dion five-horse-power voiturettes in ordinary running trim, two prizes; once around the course for gasoline vehicles not developing more than twelve horse-power, two prizes; once around the course for gasoline vehicles developing more than twelve horse-power, and once around the course for winners in all classes. The prizes are cups offered by John Jacob Astor, Mr. and Mrs. O. H. P. Belmont, Mrs. Herman Oelrichs, J. Livermore, Mr. Drexel, Mr. and Mrs. W. K. Vanderbilt, Jr., H. O. Havemeyer, Jr., the National Automobile Racing Association, and others. The start in the first race will be made at 2 P. M. from "Crossways," and the course is nine miles. Entries will be received until midnight on Aug. 28, and may be sent to W. K. Vanderbilt, Jr., or the Association at the Reading Room, Newport. The races may, however, be prevented by an injunction obtained by some of the residents.

NEW INDUSTRIAL COMPANIES.

THE STERLING ELECTRIC MOTOR COMPANY has been incorporated at Dayton, Ohio, with a capital stock of $30,000.

THE ELECTRO-CHEMICAL REDUCTION COMPANY has been incorporated at Helena, Mont., with a capital stock of $50,000.

THE NORTH AMERICAN CARBIDE COMPANY, of Newark, N. J., has been incorporated to manufacture carbide; capital, $100,000. Incorporators: William H. Wells, Joseph P. Wiswall, Charles E. Wiswall.

THE DUNMOLIN-PIERCE ELECTRIC SMELTER COMPANY, of Jersey City, N. J., capital $200,000, has been incorporated by Leonard Dunmolin, Simeon Pierce, Charles Burton, Edw. A. Greeley, John A. Quinn.

ALBANY, N. Y.—The Consolidated Battery Company, of New York City, has been incorporated, with a capital stock of $1,000,000, to manufacture electric apparatus. The directors are Daniel C. Knowlton, Arthur A. Mosher and Wm. C. Nicholas, of New York City.

THE COOPER ELECTRIC RAILROAD GATE COMPANY has been chartered at Dover, Del., to deal in all kinds of electrical work, motors, etc. Incorporators: Thomas O. Cooper, Wilmington; John L. Hall, Philadelphia; James F. Dunleady, Camden, N. J. Capital, $150,000.

THE NEW STORAGE BATTERY COMPANY, of Boston, was chartered at Dover, Del., Aug. 22, to manufacture the Redding new storage battery. Incorporators: Jerome Redding and I. W. Deering, of Boston; L. D. Lathrop, of Gloucester, Mass., and Gardner W. Kimball, of this city.

THE NATIONAL AUTOMATIC FIRE ALARM COMPANY has applied for a charter at Atlanta, Ga; capital, $50,000. J. M. Stevens, G. T. Crawford and others are interested. The company in its petition states that it desires to establish a system of electric fire alarms, to construct plants for manufacturing equipment, etc.

ALBANY, N. Y.—The Swan Electric Manufacturing Company, of New York City, has been incorporated, with a capital of $250,000, to "construct and operate plants for the production of electricity and to manufacture electrical appliances." The directors are William J. Swan, William J. Berg, Herman A. Metz, Daniel Nason and John S. Comfort, of New York.

LEGAL.

SUSTAINING TESLA PATENTS.—In the United States Circuit Court of Appeals, for the Second Circuit, Judge Shipman has handed down a decision confirming that of Judge Townsend sustaining the Tesla patents, Nos. 381,968, 382,279 and 382,280, which relate broadly to the polyphase system or rotating field. The case is the well known one of the Westinghouse Electric & Manufacturing Company against the New England Granite Company. Another decision has also been given by Judge Lacombe, in the United States Circuit Court, Southern District of New York, in the case of the Westinghouse Electric Manufacturing Company against the Catskill Illuminating & Power Company for infringement of what are generally known as the Tesla "split phase" patents Nos. 511,559 and 511,560, of Dec. 26, 1893. The judge holds that the meter in suit infringes both claims of the first patent, and the first claim of the second patent named.

OBITUARY.

O. B. CHASE.—The death is announced of Mr. Orville B. Chase, secretary of the Chase Construction Company, Detroit, Mich., in an accident.

MR. H. MACKENZIE.—Hector MacKenzie, head of the well known wholesale dry goods firm of J. G. Mackenzie & Company, of Montreal, and vice-president of the Montreal Telegraph Company, died last week.

PERSONAL.

PRESIDENT C. A. COFFIN, of the General Electric Company, has sailed again for England.

DR. A. E. KENNELLY has an interesting article in the *Saturday Evening Post* on the development of telegraphy.

MR. C. O. BAKER, JR., has just returned to the city, after a prolonged absence, and is well and hearty, but quite reticent about his foreign travels.

MR. GEORGE WESTINGHOUSE returned from England last week, having, it is said, transacted some very important business while abroad.

PROF. J. J. THOMSON has in *Harper's Magazine* for September an excellent popular article on the cathode rays, Röntgen rays, etc., and their relation to the corpuscular theory that he has been advancing.

DR. M. I. PUPIN contributes to the *Cosmopolitan Magazine* an excellent article on recent work in electrical science and discovery. It accompanies a series of articles relative to the Pan-American Exposition.

MR. CAMPBELL SCOTT, the secretary and general manager of the C & C Electric Company, of New York, sailed for England on the "Oceanic" on Aug. 21, to be gone about three or four weeks on business for his company.

MR. A. R. BREWER, the well known secretary of the Western Union Telegraph Company, has just issued an admirable, illustrated brochure, celebrating the jubilee of the company and narrating the interesting story of its growth.

MR. T. P. McCRAY, who was formerly with the New York Telephone Company, has purchased the contracting and wiring business of Mayers & Company, of Fairmont, W. Va., and will continue it under the name of McCray & Wayman, doing business throughout a large section of West Virginia.

MR. B. J. ARNOLD, of Chicago, has, it is rumored, been retained by the New York Central Railroad on the work of electrifying the terminal tunnel in New York City. It is further reported that Mr. Arnold has been commissioned to study the problem of operating electrically the whole road between this city and Albany.

MR. A. J. J. PFEIFFER, until recently with the Compania Thomson-Houston della Mediterranea, of Milan, Italy, has completed the third rail, high speed, electric traction work on the old steam road, Milan-Gallarate-Varese-Porto Ceriso, which he went to Milan to study and execute some two years ago. He has now severed his connection with that company, and has gone to London to identify himself with the J. G. White & Company interests there. In this country Mr. Pfeiffer was connected with the General Electric Company.

Trade Notes.

THE ELWELL-PARKER ELECTRIC COMPANY, of Cleveland, Ohio, is putting up a two-story addition to its main building.

CHANGE OF NAME.—The Victor Telephone Manufacturing Company, of Chicago, has changed its name to International Globe Company.

THE NATIONAL BRIDGE COMPANY, of 45 Broadway, New York, have just just completed the erection of a bridge for the Lehigh Valley Railroad at Copley, Pa.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, have recently made a large shipment of Cross oil filters and Burt exhaust heads to Copenhagen, Denmark.

CATALOGUES WANTED.—The Central Electric Company, 101 North Fourth Street, Harrisburg, Pa., desires to receive catalogues and price lists from manufacturers of electrical house goods.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, has just issued a "Complimentary Meter Book." This book is a small edition of the regular F. & H. meter book, and is being sent free to the trade.

THE INCANDESCENT ELECTRIC LIGHT MANIPULATOR COMPANY, Boston, Mass., reports that the demand for its goods has increased to such an extent that it has been obliged to move its factory to larger quarters at Quincy, Mass.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, recently organized in Niles, Ohio, has commenced the manufacture of incandescent lamps. Only a few hands are at work at present, but the number will be increased to the full capacity of the plant in the near future.

COAL HANDLING MACHINERY.—A general idea of the line of machinery manufactured by the Jeffrey Manufacturing Company, of Columbus, Ohio, is obtained from a little pamphlet of recent issue by that company. The pamphlet contains illustrations showing the various uses to which this conveying apparatus can be adapted.

RESISTANCE UNITS.—Bulletin No. 8, just issued by the Carpenter Enclosed Resistance Company, 79 East 130th Street, New York, contains a price list of Carpenter resistance units of various sizes. These units are stated to have an ample margin of safety for overload, low temperature rise, and will not burn out in service.

THE NATIONAL BATTERY COMPANY, of Cleveland, Ohio, manufacturer of the Sperry storage battery, is preparing to remove its plant from Cleveland to Buffalo, where the plant is to be run with power from Niagara Falls. An office has been established in Buffalo. Mr. J. P. Devine, formerly a branch manager for the American Bicycle Company, has accepted the position of manager of the National Battery Company.

THE NEW PROCESS RAW HIDE COMPANY, Syracuse, N. Y., reports that it has been obliged to run its bevel gear planing machines nights during the past week in order to rush through a number of large bevel gear wheels to repair a breakdown for a big New England wire drawing concern. The bevels are of cast iron with teeth planed accurately to cone lines, and are to take the place of cast gearing.

JUBILEE EXHIBIT.—In a pamphlet just issued is given a report of the Jubilee Exhibit held in connection with the Jubilee International Convention of the Young Men's Christian Associations of North America, in Boston last June; also a report of the boards of judges and lists of awards of merit. Several full-page illustrations show exhibits of Associations from different cities. Mr. Geo. B. Hodge is secretary of the Educational Department.

FUSE BLOCK.—In our issue of Aug. 3 was described and illustrated a new fuse block, the invention being ascribed to "Mr. W. R. Goodwin," of the Chicago Fuse-Wire & Manufacturing Company. The types unfortunately gave the credit to the wrong man, in changing the name Goodman to Goodwin. The friends of Mr. Goodman no doubt, however, recognized in the published name that of Mr. W. R. Goodman, manager of the company.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently marketed, under its own name, a new dry battery called the "Wesco." It states that this battery is meeting with an extremely flattering success, as the demand is very large. The company is also getting out a new brand of friction tape called "Wesco." It has done this to fill a long-felt demand for tape which is moderate in price, and at the same time first-class in quality.

TRAVELLING CRANES.—The Cleveland Crane & Car Company, of Cleveland, Ohio, manufacturer of electric traveling cranes, reports a very satisfactory demand during the usually quiet summer months. It is furnishing a 30-ton, 4-motor electric crane with 75 ft. span, to the J. S. Coxey Foundry Company, Mt. Vernon, Ohio; a 15-ton, 3-motor crane, with 50-ft span to the Boston Elevated Railway Company, Boston, and a number of smaller shipments.

220-VOLT LAMPS.—The Central Electric Company, of Chicago, claims a high quality for the Columbia high-volt lamps, and solicits a trial order, which it believes will convince the purchaser as to their superiority. The Columbia 110-volt lamps have proven a success for the past twelve years, and from the outlook its 220-volt lamps will enjoy the same experience. The Central Electric Company carries a large stock of lamps in all voltages and candle powers, also street railway lamps.

SIGNS OF THE TIMES.—The Electric Motor & Equipment Company, 12 Beaver Street, Newark, N. J., has issued a very complete catalogue of 80 pages describing its electrical decorative devices and advertising effects. Many of these devices have moving parts, and others produce the effect of movement by the alternate illuminating and extinguishing of adjacent lamps of different colors. This field is a rapidly growing one, and the catalogue will be of interest to those in this expanding trade.

THE ONONDAGA DYNAMO COMPANY, of Syracuse, N. Y., has just added to its types of "power producers" a special motor (6 and 8-pole) for running printing presses and tools requiring slow and variable speeds. These motors run at from 100 to 200 revolutions and in their construction space is economized to the highest degree. Their compactness is shown in the statement that a 10-horse-power at 200 revolutions is only 35 inches extreme diameter. Already these neat little machines are meeting with a ready sale.

THE SPRAGUE ELECTRIC COMPANY has been obliged to run the New York factory at night for some time to meet the demand for its flexible conduits for interior wiring. The new flexible products are very popular, and will continue the reputation for superiority that the Sprague Company's conduits always have enjoyed. The superior qualities of the Greenfield flexible steel armored conductors and cords are simplicity of installation, thorough protection of wire and insulation from mechanical and other injury, and high grade insulation at low cost.

GRAPHITE FOR AUTOMOBILES.—The Joseph Dixon Crucible Company, Jersey City, N. J., has developed a new field for the application of graphite, namely, for steam, gas and electric automobiles. In a little 12-page pamphlet published, some experiences with graphite lubrication of automobile bearings are given. It is pointed out in the pamphlet that graphite has a strong mechanical affinity for metallic surfaces and makes a veneer-like coating of marvelous smoothness and endurance. The company will be glad to send samples of its graphite lubricants to responsible and interested parties.

THE GRANT TOOL COMPANY has removed its plant from Cleveland, Ohio, to Franklin, Pa., and is prepared to fill orders from its new factory. Mr. John J. Grant, who has had a long and comprehensive experience, has personally designed the tools built by this company, which are unique in many of the details of their construction, as the result of his careful personal attention. The line includes hand lathes, upright drills, milling machines, positive taper stud and bolt lathes, automatic worm-wheel cutting machines, heavy turret chucking and turning machines, etc. The catalogue the company issues is well worth studying.

DURAX GLASSES.—Messrs. Schaffer & Budenberg, Brooklyn, N. Y., are placing upon the market a new steam gauge glass known as "Durax Glass." This glass is stated to be an improvement on the compound glass introduced in this country some years ago and known as the "Jena Compound Glass." The Durax glasses have a light blue stripe as a trade mark, which distinguishes them from all other gauge glasses. In a circular of recent issue the firm gives a table of results of comparative trials with these glasses to determine the resistance against sudden changes of temperature and drops of cold water blown against them. According to the table Durax glasses appear to be four to six times stronger than the average English or French glass, and have such an advantage over compound glasses as to justify their use in preference. Durax glasses are recommended for use on all boilers, especially those exposed to the weather and sudden change of atmospheric temperatures.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, general sales agent for the Browning Manufacturing Company, reports that the success of the new type small Browning generators and motors has been extremely gratifying. Wherever it has installed them, they have given entire satisfaction. It further states that these small machines are the very highest grade obtainable, the material and workmanship the best, being tested by four-hour run at a 10 per cent overload and a one-hour run at a 50 per cent overload before leaving the factory. They are made of the best cast dynamo steel, slotted armatures, with self-oiling bearings and carbon brushes. These machines were especially designed to fill a long-felt want, that is, a perfect small motor or generator. They are made in sizes from 1-5 to 3½-hopse-power and from ¼ to 2½ kilowatts. They are especially adapted for both heavy and light work and are sold under the strongest guarantee. The company has got out a very attractive Bulletin on these motors and dynamos, which will be sent on application.

FIRE IN "NEW STANDARD" BATTERY WORKS.—A disastrous fire broke out early Monday morning, Aug. 19, in the five-story building occupied exclusively by Wm. Roche, the manufacturer of the New Standard Dry Battery, at 42 Vesey Street, New York City. The fire was discovered on the fifth floor, where the batteries are manufactured and ingredients prepared. The damage extended to the fourth floor, where the connections on the batteries are made, and where they are packed; and also to the third floor, where the zinc cups are made and the labels are put on. The first and second floors, where offices, shipping and store rooms are located, escaped serious damage, except by water. Mr. Roche stated to a representative of ELECTRICAL WORLD AND ENGINEER that his loss would exceed $10,000, partially covered by insurance. He further says that when he remodels the floors that were burned out he will put in new machinery, and will be able to increase his facilities over what they were before the fire. He hopes to be able to resume manufacturing in about a week. Orders were especially plentiful when fir occurred.

DRAKE, BREED & COMPANY.—The firm of Drake, Breed & Company, of Philadelphia, was incorporated July 24, 1901. Messrs. Drake and Breed are both men of long experience in the electric railway field. Mr. Drake was for years the right-hand man of the late Albert L. Johnson, and at the time of the latter's death was at the head of the great electric railway system centering in Allentown with the roads projected and building to connect New York and Philadelphia. He was for a number of years vice-president and general manager of the Nassau system in Brooklyn, and in an important capacity in the street railway system of St. Louis. Mr. Geo. Breed is a graduate of the United States Naval Academy, and was from 1890 until the time of the war with Spain connected with the General Electric and Westinghouse companies. He was retained by Mr. Johnson to design the power stations and supervise the electric equipments of his projected roads. The new company was formed with a view to completing this work and to enable it to push efficiently other large enterprises now in hand.

RUBEROID EXHIBITION ROOFS.—One of the main topics of discussion in Central Europe is the Art Exhibition which will be held at Karlsruhe, Baden, next year. This exhibition is one of great international interest, and its opening will find many American connoisseurs present. The buildings in which it will be held will be works of art. As usual, American products will figure prominently, not alone in the exhibition itself, but in the actual equipment of the magnificent buildings in which it will be held. For instance, the well

known Ruberoid roofing, manufactured by the Standard Paint Company, will cover the roofs of the immense buildings. Through their Hamburg (Ger.) factory, the Standard Paint Company have delivered the very large quantity that is necessary to roof the big structures. Recently a large lot of Ruberoid was delivered to the Russian South West Railway to cover a number of buildings which they are erecting. The Baldwin-Ziegler Polar Expedition took a lot of it. The United States and German troops in China live in barracks roofed with Ruberoid. In the De Beers mines, South Africa, Ruberoid is also in use. From there to the Klondike gold fields is a long jump, but there also is Ruberoid doing duty. Australia, Scandinavia, Germany, Spain, Austria, Italy, Egypt, West Indies, Philippine and Hawaiian Islands—every part of the world, in fact, knows of and uses Ruberoid, which has proved itself adaptable to any climate.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUGUST, 20, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

680,693. PRINTING TELEGRAPH; J. Burry, Fort Lee, N. J. App. filed April 13, 1900. General improvements throughout a printing telegraph instrument designed to increase the speed and efficiency.

680,695. TRANSMITTER FOR EDUCATIONAL PURPOSES; C. S. Comins, Quincy, Mass. App. filed March 26, 1900. A perforated strip transmitter intended to operate a sounder in a local circuit to familiarize the student with the sounds of the different characters.

680,704. ELECTRIC TRACTION ROAD; L. Dion, Boston, Mass. App. filed Nov. 24, 1900. The studs in the roadbed contain a quantity of metallic spherical bodies which are lifted into contact with the head of the stud by a magnet on the car, and thus establish connection between the feeder and exposed conductor.

680,792. ALTERNATING-CURRENT INDUCTION MOTOR; B. G. Lamme, Pittsburg, Pa. App. filed May 24, 1899. (See Current News and Notes.)

680,793. DYNAMO ELECTRIC GENERATOR; B. G. Lamme, Pittsburg, Pa. App. filed June 28, 1900. (See Current News and Notes.)

680,795. STRAP COIL FOR ELECTRICAL MACHINES; J. P. Mallett, Pittsburg, Pa. App. filed Oct. 17, 1899. A strap coil for electrical machines comprising a plurality of separately insulated, complete, side-by-side turns without joints.

680,797. ELECTROMAGNETIC MOTOR OR RECIPROCATING ENGINE; R. D. Mershon, New York, N. Y. App. filed Nov. 2, 1899. (See Current News and Notes.)

680,798. MECHANISM FOR GENERATING VARIABLE ELECTROMOTIVE FORCE; J. E. Miller, Edgewood Park, Pa. App. filed March 1, 1900. Means for producing a variable electro-motive force comprising an electric motor driven from an approximately constant potential circuit, a generator mechanically connected to and driven by said motor, and means for increasing the field magnet strength of the generator and decreasing that of the motor simultaneously, and vice versa.

680,804. ELECTRICALLY PROPELLED VEHICLE; F. J. Newman and J. Ledwinka, Chicago, Ill. App. filed Jan. 18, 1901. A motor embodied in the hub of the wheel, its parts being supported entirely independently of the axle.

680,808. RHEOSTAT; T. S. Perkins, Idlewood, Pa. App. filed Sept. 28, 1898. Comprises a helical, flattened coil of wire in spiral form and a strip of insulating material interposed between adjacent convolutions of the wire.

680,809. SYSTEM OF ELECTRIC LIGHTING ON CONSTANT CURRENT CIRCUITS; H. N. Potter, Halensee, Germany. App. filed Oct. 3, 1900. A pilot lamp is placed in a shunt around a multi-glower lamp and is thrown into circuit when one of the glowers of the main lamp breaks.

680,824. CONTACT DEVICE FOR ELECTRIC RAILWAYS; G. Westinghouse, Pittsburg, Pa. App. filed Feb. 28, 1896. (See Current News and Notes.)

680,834. HOUSE WIRING; F. Bathurst, Southfields, Eng. App. filed Oct. 30, 1899. A conduit having insulating lining, the conduit itself forming one side of the circuit and the inclosed bare conductor forming the other side.

680,848. ZINC ELECTRODE FOR ELECTRIC BATTERIES; W. Erny, Nalle-on-the-Saale, Germany. App. filed March 6, 1901. A spongy zinc amalgam is applied to the side of the zinc cylinder and held in place by a second perforated zinc cylinder.

680,879. TELEPHONE EXCHANGE APPARATUS; F. R. McBerty, Evanston, Ill. App. filed Dec. 26, 1899. In a central energy system, an arrangement of circuits whereby one annunciator at the switchboard will serve for the calling and ring-off signals.

680,880. CONNECTION REGISTER FOR TELEPHONE EXCHANGES; F. R. McBerty, Evanston, Ill. App. filed Dec. 26, 1899. The register is operated by a polarized electro-magnet, current being sent through the magnet automatically when the called subscriber responds.

680,881. SELECTIVE CALLING KEY FOR PARTY LINES; F. R. McBerty, Evanston, Ill. App. filed Jan. 6, 1900. A key pivoted to move in four different directions to make selective connections.

680,890. CONNECTION COUNTER FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed Dec. 26, 1899. One circuit operates the counter when the called subscriber responds and another circuit locks the counter to render it inert to subsequent changes in the electrical condition of the called line.

680,901. SIGNALING DEVICE FOR CARS; W. W. Ward and J. Kean, Fair[illegible] Minn. App. filed May 15, 1901. Details.

680,91[illegible] TROLLEY GUIDE; G. F. Heusner, Portland, Oregon. App. filed Dec. 13, 1900. Outwardly flaring arms attached to the trolley wheel.

680,922. OUTLET BOX; H. Ill, Newark, N. J. App. filed Jan. 11, 1901. The openings are covered by lids connected at one place only in the periphery so that when broken out, they will leave a smooth circular opening for the entrance of wires.

680,932. INCANDESCENT LAMP SOCKET; N. Marshall, Newton, Mass. App. filed Aug. 8, 1900. Detail of fastening the cap and body together.

680,968. ELECTRIC FUSE OR CUT-OUT; L. W. Downes, Providence, R. I. App. filed May 2, 1901. (See Current News and Notes.)

680,981. ELECTRIC SWITCH; M. H. Johnson, Utica, N. Y. App. filed May 27, 1901. Each blade is double and engages with a U-shaped clip.

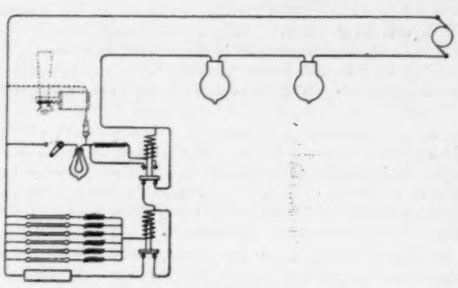
680,982. BURGLAR PROOF DEVICE FOR SAFES; A. T. Metcalf and V. D. Simons, Battle Creek, Mich. App. filed March 5, 1901. Details.

681,002. MOTOR METER FOR ALTERNATING CURRENTS; A. Peloux, Geneva, Switzerland. App. filed March 8, 1901. (See Current News and Notes.)

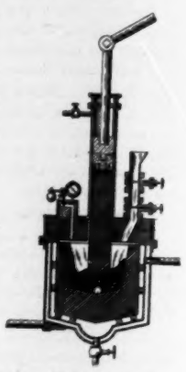
681,030. RAILWAY SIGNALING; F. McBrien, Newark, N. J. App. filed Dec. 3, 1900. The object is to prevent a break in the signal during the operation of the circuit changer, thereby preventing the home signal from going to danger during such operation.

681,039. ELECTRIC RAILWAY; W. Chapman, Washington, D. C. App. filed May 29, 1896. In a system having pick-up and feeder circuits, a motor generator is used which takes current from the feeder circuit and supplies current of lower tension directly to the pick-up circuit.

681,099. METHOD BY WHICH SEVERAL TELEGRAPHIC MESSAGES CAN BE TRANSMITTED AT THE SAME TIME THROUGH ONE CONDUCTOR OR BY WIRELESS TELEGRAPHY; A. Bull, Cologne, Germany. App. filed May 8, 1900. Consists in transmitting each sign by means of series, each series consisting of a pre-determined number of short impulses following one another at different intervals of time.



680,809.—System of Electric Lighting on Constant Current Circuits.



681,107.—Electric Furnace.

681,107. ELECTRIC FURNACE; A. H. Cowles, Cleveland, Ohio. App. filed July 20, 1895. An electric furnace having its walls permeable to vapors and gases and a condensing chamber outside of the permeable wall.

681,112. CARBON BREAK FOR ELECTRIC SWITCHES; H. D'Olier, Jr., Philadelphia, Pa. App. filed May 13, 1901. A carbon member is held in contact with the switch blade during a portion of the movement of the latter.

681,119. TROLLEY SWITCH; W. P. Hines, Portsmouth, Va. App. filed Oct. 20, 1900. Details.

681,127. FIRE ALARM SYSTEM; C. E. Lombard, East Wilton, Me. App. filed March 14, 1901. Details.

681,133. STARTING APPARATUS FOR ELECTRIC MOTORS; T. S. Perkins, Idlewood, Pa. App. filed Sept. 28, 1898. The mechanism includes a double pole line switch.

681,157. CONDUIT; C. A. Wanner, Philadelphia, Pa. App. filed July 6, 1901. A conduit having grooves on two sides and lugs on the other two sides, said lugs being shaped to enter grooves in the adjoining conduit-sections.

681,167. ELECTRICAL CONTROLLER ATTACHMENT; G. L. Fairbrother and A. H. Mathewson, Thompsonville, Conn. App. filed April 19, 1901. The attachment consists of a plate having swinging lugs in the path of the controller handle and the handle carries devices for pushing the lugs out of the way.

11,929. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed June 18, 1901. The invention contemplates the use of electromagnetic supervisory signals controlled by the relays, each signal having two windings differently disposed, one of which is in a local circuit closed in making connection with a line and the other of which is in a branch of the local circuit controlled by the supervisory relay to be closed when the relay is excited.